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Engineering News-Record

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January 14, 1926

The Year 1925 in Civil Engineering and Construction

The Year's Accomplishments

A review by the editors of progress during 1925 in the various fields of civil engineering and construction

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Engineering Education

Review of the studies of the Society for the Promotion of Engineering Education under the auspices of the Carnegie Foundation

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The greatest real estate craze in history through engineering eyes

Highway Bridge Works in 1925

A summary of the volume of highway bridge construction in 1925

and

Engineering News-Record Annual Statistics of the Construction Industry

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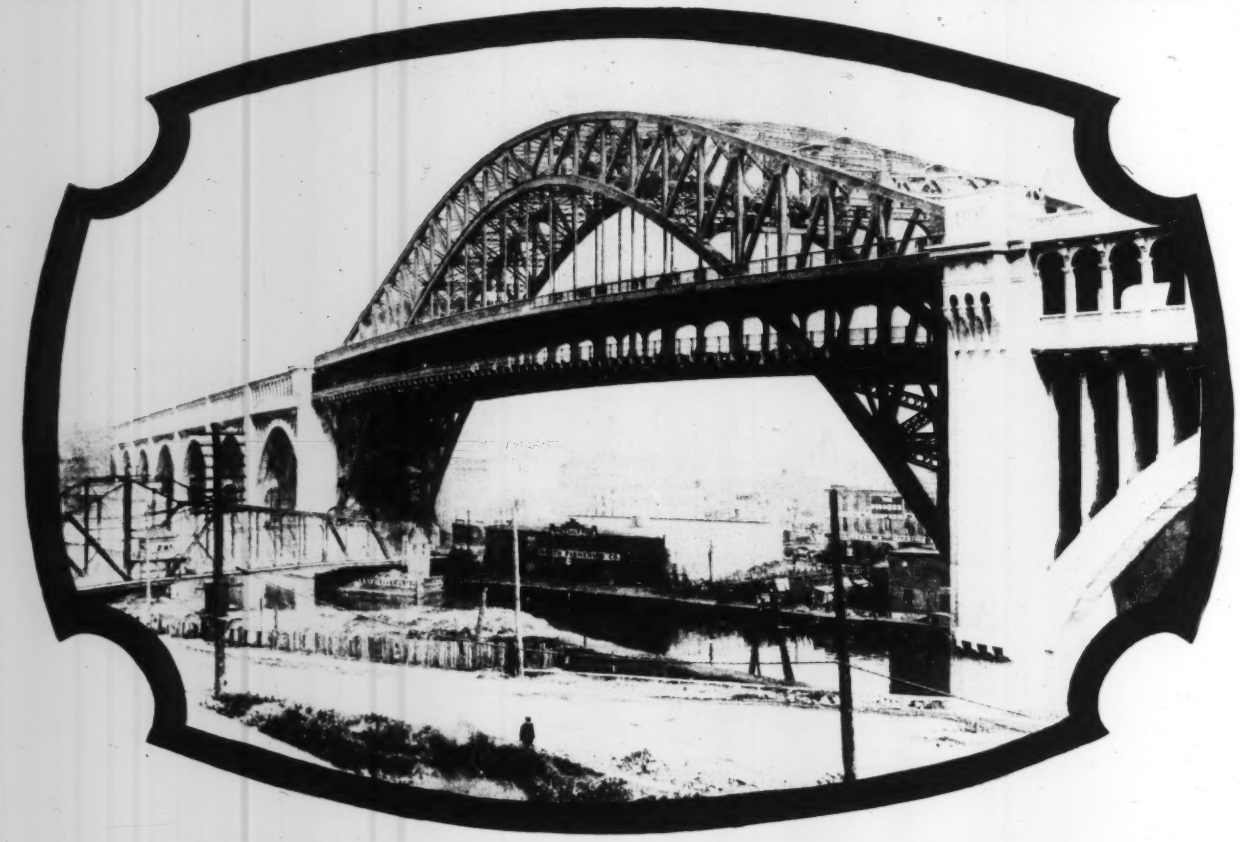

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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

FRANK C. WIGHT
Editor

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This Issue

CIVIL engineering has become so diversified that no one man practices in all of its ramifications; specialists more and more tend to confine their attention to one limited field to the disregard of all others and, we believe, to the detriment of their effectiveness in the field where they have become expert. For in spite of diversification engineering is an integral art made up of functional operations common to all the branches of the art. Each specialist, therefore, may learn from the other, for the technique of the functions is being developed by all. In a way, then, every article in *Engineering News-Record*, assuming it has been well chosen to appeal to the practitioner in the branch to which it belongs, is of importance to the practitioner of every other branch. Once a year, however, the editors bring together a general review issue which disregards specialties and considers engineering and construction as a whole. This is that number. It presents first a review by the editors of the outstanding engineering development of the year, including in that development not only the actual practice of engineering but to some degree the economic status of the world and the country as it affects engineering. It collects for the year just gone those statistical data of construction volume and cost which picture the physical progress that has been made. It reviews pictorially the major engineering projects under way, and finally it presents a group of articles on subjects in which, it is hoped, even the most intense specialists will find a common ground.

Economic Factors

WE START the new year with the economic world on an even keel. With some minor differences the prospects for 1926 are the same as were those for 1925 a year ago, because the predisposing conditions are so little changed. Apparently for a time at least a certain stability has been achieved in industry and in politics which conduces to general prosperity. The one danger is that this condition will lead on the one hand to a smugness of thought which is a foe to progress or on the other to an undue optimism which translates itself into speculative adventure.

By any material index, however, 1925 was a most prosperous year. Production was high but kept only a necessary small step ahead of a rising consumption, unemployment was almost non-existent, and real wages kept level or if anything rose somewhat in most trades. Savings bank deposits and insurance company assets testify to an increasing surplus of money which surplus is apparently distributed among all classes. Transportation agencies showed some signs of recovery from the war and post-war blight. Our foreign trade balance became more favorable, in spite of our higher costs of production. Construction, the basic index of prosperity, rose to unprecedented and unpredicted volume. Labor troubles, except in the perpetually disturbed coal industry, have been few which indicates a general satisfaction with the wage scale and a sufficient labor supply, in spite of the falling off in immigration.

There can be no denying that such evidences of prosperity carry the germs of that overconfidence that always precedes industrial and financial depression or collapse. The business men of this generation should be warned against such overconfidence by the debacle of 1920, and the even progress of the past two years testifies to the efficacy of that warning, but there are signs that prosperity is proving too much for some and that too much money is leading to rampant speculation. The stock market boom of the fall of 1925, the widespread real estate craze most virulently exhibited in Florida and the runaway production of buildings—all are indication of the beginning of a movement which may get out of hand. Except for that possibility and for the continuing undervaluing of farm products the prospects for the year are so good as to make one wonder if there is not lurking around the corner an unrecognized source of danger.

National and World Conditions

ENGINEERING finds its practical expression in construction and construction ebbs and flows with the economic state of the world. That economic state, in its turn, responds, slowly to be sure, to nation-wide and world-wide political stimuli. These political conditions therefore should be searched for possible influences on engineering construction.

The political policy of the United States is, by virtue of the war, now interwoven with the whole world. Partly because of our natural advantages, partly because of the genius for productive efficiency of our people, we now occupy a most fortunate financial position in an otherwise depressed world, the most part of which regards us with added envy because it owes us money. We continue to produce more than we can use and to try to sell that surplus to these debtors who are finding it difficult to produce even enough to balance what they buy from us much less to pay us what they owe. There are those who recommend as a way out that we cancel all such debts and start afresh, forgetting that to do this is not only to violate all precedent of national obligation but to set up a precedent which will endanger all future international dealing. There are those, too, who demand a Shylockian pound of flesh, forgetting that one cannot get money where money does not exist. The United States has so far steered a middle course, insisting on the fulfillment of the obligation but only to the extent of the capacity of the debtor to pay. Providing always that this capacity

has been accurately gaged, the policy is one which will lead to the earliest stabilization of world conditions, and it is to be hoped that Congress will see fit to back up the administration.

This country has certain obligations toward Europe, for the welfare of the world is our welfare. It is, we believe, the majority opinion of the country that participation in the World Court is one way to help satisfy that obligation, because it will be one more step toward that mutual effort to perpetuate peace of which the Locarno pact was a European testimonial. Europe is still in the pangs of reconstruction, with France the farthest from recovery and until some greater degree of stabilization takes place there, international complications will continue to threaten the economic body of the whole world.

Nationally, the President continues to emphasize his economy and tax reduction campaign. Thanks to the huge income of the nation taxes are continually being reduced but it appears that the program of economy has about reached its lowest possibility. For the current year the budget is higher than last. This, however, is not to be deplored for at best little more water can be squeezed out of national expenditure without serious impediment to national progress.

The states and the smaller political subdivisions have been affected by the publicity of the Coolidge economy program to the extent that all expenditure is more closely scrutinized than ever before and any tax raise becomes the occasion for more than usual complaint. The general benefit is not strikingly evident as yet, for taxes remain high, though the adverse effect of these high taxes on the individual has been much exaggerated. So far the economy campaign has not reacted dangerously in a recession of needed public work.

Combinations and Holding Companies

SIGNIFICANT during the year has been the changing attitude of the federal government toward business combinations. The Supreme Court decisions in the maple flooring and the cement cases were accepted by the Department of Justice as indicating a more lenient view toward the trade association. Superficially these decisions and the administration viewpoint have been considered as approving combinations which during the years of the Sherman and Clayton Act prosecutions were distinctly illegal. In reality all they did was to approve a more liberal interpretation of the rights of a given industry to collect and distribute its production and sales statistics, on the theory that production based on full information will approximate a prospective consumption and will therefore tend to common trade efficiency. Industries, however, have been warned that this is not license to combine in restraint of trade and that the criterion of legality will continue to be the undue extension of this restraint. More ominous in its prospect than the occasional belief of business that the way is now opening to that illegal combining which once was known as the trust is the growing tendency of big business of every form toward the holding company, with its usual concomitant of the non-voting common stock issue. Every sign points to the belief on the part of the financier, and his sinister adviser the corporation lawyer, that in the holding company is being developed the machinery which is at once legal, safe, and profitable for the fortunate few. Insofar as the public utilities are concerned there is much to be said for the technical efficiency of the holding company. It concentrates management in intelligent and trained experts, it reduces overhead and it pools purchases and, during successful operation at least, it rewards the consumer in reduced rates. But against this it sets up a non-resident directorate out of touch with the consumer and it rests real control in an impersonal financial entity most difficult of supervision by the public. Even the most bigoted private ownership advocate realizes that the only answer to privileged monopoly is public control. Any legal device which tends to destroy that control is doomed. It requires no prescience to predict that the next few years will see a growing effort on the part of the people to check the financial operators who are moving so fast toward the accumulation of the highly profitable voting shares in large and diversified holding companies, the capital for which is furnished by stock and bondholders who have no voice in management and indeed in many cases only a depreciated equity in the over capitalized property.

The Engineering Year

The Building Boom

AS THE statistics for the year on other pages show 1925 was the record construction year. Based on the best evidence that it can gather *Engineering News-Record* estimates that the total cost of construction in the United States in the year 1925 was seven and one-half billion dollars, as compared with six billion in 1924 and five and one-half in 1923. This total, it must be noted, is not the sum of construction projects listed in the "Construction News" section of this journal, but the sum total of all construction including the smaller cost buildings and projects which this journal does not attempt to list. These larger projects total in 1925 about two and one-half billions as against two billions in 1924.

The interesting thing about both figures, however, is that the unexpected and unprecedented rise in construction is largely in buildings. Fully eighty per cent of the increase over 1924 was in building construction. There was some increase in almost every other kind of construction but not much more than the normal increase of population, which as is sometimes forgotten is a measure of demand and therefore of normal supply. But buildings have run far beyond anyone's predictions. Not only that but the commitments for the early part of the year indicate a continuation of the building boom.

There is great difficulty in measuring the prospective progress of this boom. It has been mostly in residential and office building construction, which indicates that we are trying to fill up the housing gap left by the war. But that gap must be nearly filled by this time and a large part of the new building is to take care of the rising standard of living which is a by-product of prosperous times. Added to that is the speculative craze previously alluded to, which craze has always for its earliest manifestation the gambling in futures in providing housing.

Taking all such factors in evidence it would appear that construction for the coming year will be less than

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in 1925, though probably up to 1924. Industrial building to call for increased business should continue normal and public work shows no sign of a pronounced decline, but a falling off in residential construction, especially in the big apartment, hotel and tenement, may be looked for by the middle of the year. Capital is beginning to be concerned at the mad rush into such kind of building and loan money will undoubtedly tighten.

Construction Technique

CONSTRUCTION as an engineering operation exhibited no marked advance in 1925. The trend of recent years toward the greater use of machinery and toward better processes has continued. The improvement of equipment has gone on steadily, fitting it better to its tasks. In general there has not been corresponding improvement in operation. Studies made during the year in road building, show general lack of full efficiency. There has been no considerable reduction in lost time, except in the respect that winter building construction has increased. Another exception to the general trend is exhibited by recent subway construction in New York and Philadelphia. Here notable invention has been shown in improving practices. In concrete construction, sand inundation has come more to the front, but other equipment and operations have changed in no way except, perhaps, they are being handled with more skill. In education in construction two events of importance have to be noted: The Bureau of Public Roads is carrying on extensive research studies of road building practices and efficiency, and the American Society of Civil Engineers has planned to organize a construction section to handle the developing technique of construction.

Building Developments

TECHNICALLY in building there have been no marked developments. The same steady activity in the revision of municipal building codes that has prevailed for a number of years was continued. In a few cities a special stir developed over inefficient municipal building supervision, as noted two weeks ago (Dec. 31, p. 1088) with respect to San Francisco. The high level of prices—building costs are still something more than twice as high as in 1913, and at least 20 per cent above the commodity-price level—continues to turn attention to methods of increasing the economy and efficiency of building through increase of working stresses and decrease of live-loads and fixed construction requirements. The efforts of the Department of Commerce toward establishing a uniform basis for all building codes, which continued actively during the year, rest on a similar motive.

Two prominent items in the campaign for efficiency were the completion and discussion of the report of the Joint Committee on Concrete, which proposes very high working stresses for this material, and the report of a committee of the American Society of Civil Engineers recommending a decided increase of working stresses for structural steel (20,000 lb. per square inch in place of the traditional 16,000, although the two figures are not directly comparable). Agitation by the steel fabricators for the general adoption of an 18,000-lb. basic stress for steel in city building codes, which led to adoption of this figure by quite a number of cities, and the tentative endorsement of this stress by the Building Code Committee of the Department of Commerce further emphasize the progressive trend in the structural engineering of buildings. At the same time, the extensive discussions over these subjects have brought to light an unexpected amount of inertia in structural engineering circles, so that in a number of instances city councils and lay officials endorsed and authorized working-stress increases in the face of hesitancy in local engineering circles to approve the increase.

One rather memorable development in the building field is the attention which has come to be centered on the earthquake risk because of the Santa Barbara earthquake and attendant events. It was revealed by the occurrences at Santa Barbara that a great deal of building which is entirely presentable externally is full of weak spots, which an earthquake shock quickly searches out. The evidence supported previous indications that well designed and substantially built structures are fairly well proof against earthquake shock even though not specifically designed therefor; while the additional strength needed to give a satisfactory degree of earthquake resistance is not costly or difficult to provide. For the first time, large numbers of people have begun to suspect that the earthquake risk is rather more universal than has been tacitly assumed, and that if we wish our buildings and our cities to survive unharmed for a long period of time we ought to take the possibility of an earthquake shock into account. Such large blocks of wealth are invested in buildings, and such concentrated masses of people depend for their life and comfort on city facilities, that there is reason to look with apprehension upon even a distantly remote chance of destruction or extensive disorganization of a large urban community.

New Structural Knowledge

THERE has been rather more advance in the sciences underlying structural engineering than in a number of previous years. With the exception of the brilliant soil researches of Terzaghi recently reported in our pages, no outstanding results of novelty are to be noted, yet the increased appreciation of the need for scientific progress cannot be overlooked. Secretary Hoover recently made public plea for more attention to explorations in basic science, but the facts are probably somewhat ahead of him in this instance, as the drift toward scientific inquiry and research has within the last few years been strong and unmistakable. Engineering sciences have shared in the reawakening of the investigator's hopes and ambitions, and this in no insignificant degree in the structural field. The great enterprise of experimental study of arch dams, including failure tests of a full-sized experimental dam, now in preparation, is an illustration, though a rather unusual one. Actual construction of the test dam, by the way, began within the last few months. In harmony with this work test provisions have been incorporated in the structure of one or two other dams recently built in the West, which will make it possible to check and extend the knowledge obtained from the experimental dam.

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Construction Equipment

PROGRESS in the field of construction equipment when expressed in general terms, follows much the same line year after year—improvements and refinements in mechanical details. In this respect 1925 was noteworthy. On the other hand, developments in the materials of construction have not been as radical as in 1924 when the simplification programs in paving brick, asphalt, steel reinforcing bars, and other materials were so enthusiastically pursued. However, 1925 has proved the wisdom of the limitation of varieties adopted in 1924. A survey of the asphalt producers shows that less than 10 per cent of the sales for the year were of other than the ten recognized varieties. One further variety of paving brick was eliminated, reducing the number to four. There was evident a demand for a thinner brick probably 2½ in. thick and a broadening in the use of centrifugal cast-iron pipe.

One of the most notable developments in construction machinery has been furnished by the concrete mixer manufacturers who have gone beyond the standards originally set by the Associated General Contractors' bureau by bringing out a 27-E paving mixer. Equipment was introduced in 1925 that aids in placing laboratory methods of concrete proportioning on a practical job basis. Hoppers that weigh the sand and stone, equipment for sand inundation and a beam-scale machine for applying the water-cement ratio were among the most notable.

Power shovels and cranes as usual enjoyed their share of the improvements. Especially was this true of the power plants. Practically all machines are made with electric motors, steam, gasoline or Diesel engines as optional equipment. The Diesel power unit continued to grow in popularity.

More speed was a demand of the contractors that the equipment manufacturers endeavored to meet during 1925. Propelling speeds on mixers, cranes and shovels were increased. In one instance two-speed gearing was used for both propelling and hoisting. Tractors were geared up for faster operation of graders, scarifiers, snow plows, dump wagons and other trailing equipment. Synchronizing of concrete mixer operations, permitting the skip to be hoisted while the drum is discharging and the performance of these operations automatically speeded up concreting work. Also the use of extra large water valves was introduced to decrease the time necessary for the materials to remain in the drum. Motor graders mostly for patrol maintenance purposes increased in size, sturdiness and speed.

The addition of accessory equipment, such as force feed lubricators, roller and ball bearings, high tension magnetos, flexible couplings between direct connected machines, rubber tires, springs, and safety devices, all of which are refinements added for operating economy and comfort, was noteworthy during 1925.

For the major problem of highway operation and maintenance rotary snow plows of the railroad type were added to straight and V-blade models introduced previously. Large capacity clamshell buckets designed especially for snow work made their appearance in the late fall. Electric traffic signaling devices, and new machines for pavement marking aided in the ever-increasing problem of traffic regulation.

An important tendency noted during 1925 was the use of combination machines, one power plant operating several pieces of equipment. Examples were a hoist and air compressor mounted on the same frame, compressor and air drum on power shovels for operating drills and hammers, and a pump and air compressor on a tractor. In connection with the latter, the year 1925 saw what appears to be the incorporation of the Fordson power unit in some model of practically every piece of construction equipment.

Finally, reduction of maintenance costs has been sought by the manufacturers of construction equipment by the use of alloy steels, by the incorporation of cut gears running in a bath of oil, and by the use of cast steel in place of cast iron or in some cases, on light equipment, the elimination of castings altogether and the substitution of riveted or welded steel plates and shapes.

Railroad Progress

LOOKING back over the improvements which the railroads had made during the year 1924, it was difficult, at the opening of the year 1925, to imagine that the railroads would make still greater strides toward prosperity in the year to come, but such has been the case. With few exceptions the railroads are in a much better condition financially and physically than they were at that time. This improvement is due more to internal than to external conditions; improvements and economies in operation, better car loadings and larger cars, increased car mileage, more powerful locomotives and better equipment, have all contributed their part toward the results. In addition, there has been a slight increase in the amount of traffic, and new traffic handling records have been established.

Total expenditures by the railroad companies for improvements during the year amounted to $775,000,000, or about $100,000,000 less than last year. That almost none of this money was raised by the sale of stock is an indication that the railroads still are far from being in a satisfactory condition financially. That some are in distress is evident from the bankruptcy of the Chicago, Milwaukee & St. Paul, a bankruptcy brought on by an excessively high amount of fixed charges due to the financing of the Puget Sound extension, in a large part, by bonds. Railroads in the West generally are not in as satisfactory financial condition as those of the eastern and southern districts and former Interstate Commerce Commissioner Potter has proposed that all the railroads in the West be granted a flat rate increase of 5 per cent, the proceeds of which would be pooled and distributed among the roads which fall short of earning 5¾ per cent return upon their property investment. This proposal has been attacked widely as being too socialistic.

The problem of meeting the bus and truck competition grows more serious each year. Some roads have taken the bull by the horns and have gone into the bus and trucking business themselves, building up feeder lines, in some places abandoning operation of branch lines entirely and in other reducing the number of trains. The absurd state of having the railroads and their rates controlled by the Interstate Commerce Commis-

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sion while bus and trucking companies and their rates in interstate commerce are without any similar form of control, still exists. That the consideration of this subject will be forced upon the present Congress is generally conceded and motor interests are making plans to fight any form of federal control.

Radical changes in the railroad consolidation legislation are in prospect. The Interstate Commerce Commission in its annual report recommends that it be relieved of the task of drawing up a plan for consolidating the railroads of the country into a definite number of large systems and that the railroads be allowed to develop their own systems under strict supervision by the commission.

Railroad Engineering

RAILWAY construction has seen a marked revival in 1925, and the number of projects is increasing also. Most of the construction has been in connection with and a part of the great developments in Florida, but the southwest also has some important lines under way. The greatest activity in railway work, however, has been in the widespread improvement of existing lines by double-tracking, grade and line revision, signal installations and additions to such facilities as freight stations, yards, engine terminals and coal and water stations. The Interstate Commerce Commission authorized the construction of 41 new lines or extensions aggregating 908 miles and the abandonment of 652 miles.

In track matters, of particular importance were the adoption of a standard rail length of 39 ft. and the adoption of steel rail specifications which, by the elimination of certain provisions, were acceptable both to the mill men and the railway engineers. This latter action appears to end the protracted controversy between the two parties, provided that the specifications and rails prove satisfactory. Two other points of interest are: (1) the proposition for a permanent track structure consisting of a concrete slab having steel longitudinals to carry the rails, as advocated by Mr. Alfred, of the Pere Marquette R.R., and (2) the Thompson experimental rail section on the Philadelphia & Reading R.R., having the lower corners of the rail head beveled and a proportionate amount of metal added to the top of the head. A track brake or grip brake to engage the wheels and check the movements of cars in gravity switching yards is an important device which has been put in regular service by the Indiana Harbor Belt Line and has been ordered for the new Chicago terminal yard of the Illinois Central R.R. Automatic train-control apparatus as a supplement to block signals has been applied to 2,617 miles of line and 1,323 locomotives, or 59 and 34 per cent respectively of the requirements under the 1922 order of the Interstate Commerce Commission.

In the mechanical department of railway engineering a notable feature is the steadily increasing use of rail-motor cars for branch lines and auxiliary service. Since this system is now in its development or experimental stage, it is natural that the cars are of numerous and diverse types, with comparatively few of any one type in service. Under such conditions the first cost and cost of maintenance and operation are likely to be high, but with increasing experience it is probable that there will come a considerable reduction in types.

Marked advances are being made in the power and efficiency of the steam locomotive, for in spite of a popular theory that electrification will doom the steam locomotive in the near future, the fact remains that even with the present increase in mileage main-line electrification still represents but a negligible fraction of the total railway system.

The year has been a notable one in electrification. Three projects which were well under way when the year opened—The Virginian Ry. electrification, the electrification of part of the Baltimore & Ohio lines on Staten Island, and the extension of the Long Island R.R. electrification—have been put into service. Electrification of part of the Detroit, Toledo & Ironton and of the terminal lines of the Illinois Central at Chicago is well under way. Several new projects are being considered for 1926, notably around New York City, to comply with the Kaufman Act which requires electrification of all railroads within the city limits, and the electrification of the Pennsylvania Railroad to Wilmington, Delaware.

A factor which may be expected to have a decided effect upon electrification is the development of oil electric locomotives. Such locomotives have been used experimentally for some time in switching service and now it is planned to use them in service to replace steam locomotives where electrification by ordinary means is not feasible under existing conditions.

In electric locomotives, the motor-generator engines built for the Detroit, Toledo & Ironton Ry. and the New York, New Haven & Hartford R.R. represent a new type, the engine carrying its own substation equipment and taking high-tension current from the trolley wire.

Highways

HIGHWAY improvement has settled down more firmly during the year into a continuing business involving about a billion dollars annual expenditure. About 10,000 miles of federal aid roads were completed in 1925 and perhaps 20,000 miles more of surfaced road were built by states and counties without aid from the national government. Estimates from the best sources of information forecast twelve months of equal construction activity in 1926. There developed during the year increased opposition to continued aid by the national government but the trend of thought, as indicated by a canvass of the states and the industries concerned in roadbuilding, is overwhelming in favor of continuing federal appropriations for some years at least at about their present figure of ninety million dollars a year. Indeed during the year federal aid, as it functions through the Bureau of Public Roads, has taken on increased importance in maintaining standards and in technical research. Its influence on road building has widely extended. In the line of national road development also the year has seen an important task performed in designating an 81,000-mile system of interstate highways; this is about 40 per cent of the federal-aid system and 2.8 per cent of the total public road mileage. Improvement in engineering is shown by a decided swing toward wider roads and line rectification. Construction

has advanced particularly in requiring better finish. More mileage has been put under maintenance, and the quality of maintenance is being held higher. There is a growing volume of old pavement widening and strengthening. In all ways, indeed, road operation has assumed greater importance among public roads problems.

Municipal Progress

PROGRESS in the municipal field along well tried lines continued during the past year. Physical demands outran many times the financial ability of cities to make various and extensive improvements that would undoubtedly have added to the public welfare. The problem thus presented to our cities and villages was to choose for execution those public improvements that were most pressing and that gave most promise of yielding the greatest good to the greatest number. To determine how this could be done was primarily a matter for the exercise of experienced engineering judgment. Fortunately this was recognized more than ever during the year by changes in the organization and personnel of municipal administration and by the employment of competent consulting engineers. The tendency of recent years to put engineers at the head of the construction and operation of public works, either as department commissioners or as bureau engineers of water-works, sewers and the like, was continued. Another example of progress was the continued growth in numbers of cities that have adopted the commission-manager form of government. Cincinnati, Ohio, and Kansas City, Mo., on Jan. 1 joined the ranks of large cities where the plan is in effect while Rochester, N. Y., adopted it in November. With these cities of considerable size added to Cleveland, Ohio, with its population of nearly 1,000,000 that has had the plan in successful operation for two years, it can no longer be said that the city manager plan may do very well for the small cities of the country but not for the larger ones. Aside from the fact that a large percentage of the city managers of the country have been drawn from the engineering profession, as Cincinnati has just done, the city manager idea is based on the filling of administrative offices with men qualified for the work they are to undertake, and it follows naturally that many of the appointments made by city managers will be engineers.

Water-Works

WATER supplies were one of the earliest public works provided for our municipalities and have long been on a sounder administrative and financial basis than the other public services. They were fairly established at the beginning of the nineteenth century when they were some 17 in number. At the close of 1925, information gathered by one of the editors of this journal for the *Manual of American Water-Works Practice* indicates that there were in the United States and its possessions about 10,000 and in Canada about 750 separate communities enjoying public water supplies. In the century and a quarter the ownership had changed from one public against 16 private to a probable 7,000 places supplied by municipally owned compared with 3,000 places supplied by privately owned works. In terms of population supplied, the relative percentages are probably at least 90 to 10. Increases in the percentages of municipalities enjoying filtered water and in percentage of taps metered continued during the year. Chicago and Milwaukee are now the only large cities on the Great Lakes that have not filtration plants in use or under construction. Both filtration and metering of the water supplied by the city of Chicago were virtually ordered by the War Department as conditions to the diversion of water from Lake Michigan to dilute the sewage of Chicago in its passage southwards, following the decision of the United States Supreme Court in this case. Two strongholds for so-called naturally pure as against treated water are capitulating. This is shown by the report of the special investigating committee on water supply for the Boston Metropolitan District and the city of Worcester, submitted last December, in which filtration for the entire supply, both old and new, is recommended, while across the continent and up and down the Pacific Coast the capitulation has at least gone as far as chlorination for the water supplies of San Francisco and Los Angeles and perhaps other of the larger municipalities with at least a strong trend of opinion of the state health authorities toward advising if not requiring the filtration of all surface water supplies. Elsewhere filtration of all surface supplies has been put into effect or is at least recognized as an earlier or later necessity. The need for filtration has been greatly increased by the penetration of remote and sparsely inhabited water gathering areas by auto, camping, tramping, hunting and fishing parties which is rapidly changing the feeling of security once commonly held as to the safety of the remotest sources of water supply.

The Engineering Year

Sewage and Garbage

SEWAGE collection and disposal is still far in the lead of the collection and disposal of garbage and rubbish both in percentages of cities and populations served and in efficiency of design, construction, and operation. This lead of sewage over garbage and allied services is due in large measure to the relatively greater importance of sewage collection and disposal. Lack of public and official recognition of the fact that garbage and refuse collection and disposal is an engineering problem continues to hold back the efficiency of the service. The putting into use of large activated-sludge plants for Milwaukee and for Indianapolis was a feature of the year in the sewage disposal field, as also the continuation of construction on sewage-works for the Chicago Sanitary District. An activated-sludge plant was put in operation at Mamaroneck, N. Y., which is the first if not the only one in that state and probably also in the Northeast, while in California a contract for an activated-sludge plant was let by the city of Pomona, and two associated municipalities. Considering the relative total number of sewage-works in the two countries, Canada leads the United States in the number of activated-sludge plants. In the United States, at least, Imhoff tanks with sprinkling filters where further treatment is required are still the main reliance, with fine screening coming rapidly into use either alone or in connection with other processes—notably alone for the entire sewage of Los Angeles. Recommendations by the special sewage committee of

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Detroit and its consulting engineers for treatment of the entire sewage of that city at one large plant by means of Imhoff tanks and chlorination, made at the very end of the year, bear out the foregoing statement as to Imhoff tanks.

Little change has been witnessed in methods of garbage and rubbish disposal. An apparent drift toward incineration has been checked by opposition to the proposed sites, which also retards construction in smaller places. There seems to have been no addition to the number of garbage reduction plants during the year nor much change in those already in operation, except improvements looking to greater efficiency or less production of objectionable odors. Garbage disposal by feeding to hogs seems to be at least holding its own, the most notable instance of the sort in the country and probably in the world being the hog-feeding ranch of the contractor that pays the city of Los Angeles 60c. a ton for garbage delivered at a railroad siding, transported by the contractor 50 miles into the country where it is fed to hogs sometimes reaching to 40,000 in number. Sanitary fills for garbage and refuse disposal hold their own in number and satisfaction. Oakland, Calif., has resumed ocean dumping and New York City continues the practice for the larger part of its garbage, but is gradually providing incinerators as a substitute. The use of motor vehicles for collection seems to be on the increase, especially where the haul is a long one.

Cement and Concrete

PORTLAND cement production for the year will be close to 160,000,000 bbl., an increase of about 8 per cent over 1924, which was about the percentage increase for 1924 over 1923. Increased use of cement has been normal, therefore, although the increase falls below the general increase in construction, probably because the major part of the construction increase has been in city buildings and residences where the amount of cement used is small. The year has been marked by several mergers of small manufacturing companies and the enlargement of several of the larger ones by acquisition of smaller mills. There is a pronounced tendency toward this centralization, with its economies of administration, but more desirable still with its capitalization of the national reputation for the local product. The zone of distribution of cement from the mill is small so the company with scattered plants has an opportunity for marketing that helps to take up the slack in local depressions of demand.

Technically the manufacture of cement has made no notable progress. It is becoming increasingly evident that the tests for cement fall far below an authentic prediction of cement quality, but how much of this is due to the cement itself and how much to the tests is not yet clear. Uneasiness as to cement quality a year ago, manifested especially in the appointment of the Civil Engineers' Committee, has not abated but it is at least quiescent pending the studies that committee may make and pending the announcement of some definite results from the Bureau of Standards investigation.

Little progress has been made in this country in the production of the special cements, such as high early strength portlands, which were so much discussed last year, but manufacturers are undoubtedly experimenting with them. So far no one has stepped into the field except the Atlas Company with its alumina cement, Lumnite, which has been successfully marketed for a number of special purposes. It is of higher cost than portland, however, and there are evidences that the portland cement manufacturers are to go after the apparent desire for high early strength concrete with special cements, possibly, but also by recommendation for methods of mixing and proportioning ordinary portland which will accelerate early strength.

Concrete technique is centering on precise methods of proportioning and mixing which promise a more uniform and higher strength product. The inertia of twenty years is hard to overcome, however, and the old concrete user is apt to be satisfied that he, at least, is able to produce the best concrete by methods honored by long personal usage, regardless of the demonstrable fact that the concrete so made is far from acceptable. Education is but slowly disabusing him of this notion but it is persuading the younger men that something new and valuable is being broadcasted regarding concrete practice.

Land Reclamation

BOTH stagnation and progress marked federal land reclamation during the year: Stagnation, in that no new projects were begun and only little was accomplished in putting the old projects on a going basis; progress, in that a healthy realignment of views has begun. The net results of the year, considered by themselves, are discouraging, as was indicated only recently in these columns (Dec. 17, p. 981), but when viewed more broadly they appear decidedly hopeful for future progress. The fact has emerged that the agriculture of the United States is overexpanded, and specifically that irrigation has run far ahead of the demand of farmers for irrigated land to cultivate. On the federal reclamation projects, several hundred thousand acres of land not now cultivated are available for farming, while in California, where irrigation is mainly a private and district enterprise, a million and a quarter acres that are supplied with water are not farmed. For the entire West, with more than 20,000,000 acres irrigated, the land surplus probably totals something more than one-fourth, or in excess of 5,000,000 acres. Despite the overexpansion the year was good in agriculture, with large yields and with prices ranging from moderate to high, and the federal reclamation projects benefited by this condition as much as other regions. Instead of making headway in paying up their past charges, however, the federal projects fell farther behind in payments, and increased their total delinquency more during the past year than at any preceding time.

Only on a few projects does the large delinquency in debt payments appear to be chargeable to necessity, while on many others it seems to be a last vigorous attempt to avoid the agreement to repay the government for the cost of the irrigation works. But various indications are appearing that the repudiation view is losing ground. The West as a whole is tending toward the conclusion that it is an unhealthy view, that it

reacts disastrously on morale and financial responsibility of wide circles, and that it affects non-federal irrigation development harmfully. Within the last month, at least three forceful public utterances by investment bankers who discussed irrigation securities and irrigation credit set forth the intimate dependence of future development on honest liquidation of past obligations, both private and governmental. The growth and ultimate supremacy of such opinions will mean much to the entire West.

Similar development of thought brought land settlement into the foreground during the past year. The idea has always been an unpopular one, but the showing of irrigation projects is bringing more and more people to see that it is poor business to build reservoirs and canals for a piece of desert and then leave it to languish under the vicissitudes of homesteading or become the plaything of land speculation. Encouraging and controlling settlement promises to become established as a recognized doctrine. At the present moment the chief contention seems to be whether settlement is a proper function of the state or of the federal government, with the probable result that the state will have to undertake the responsibility in view of the wide disinclination to let the federal government enter more deeply into administrative business.

The view that an irrigation project should not be undertaken unless it can pay for its cost has gained measurably in strength during the past year, in spite of the continued demand of some of the Western States for reclamation expenditures regardless of the likelihood of repayment.

Power Development

A SLIGHT falling off in the amount of new steam and hydro-electric power plants put into service occurred during the year 1925. This was to be expected in view of the large amount brought in in 1923 and 1924. However, the amount that was brought into service during the year was a very large amount in itself, the total being, according to figures compiled by *Electrical World*, 2,420,000 kva. The largest steam-electric plant put into service was a 205,100 kva. plant at Kearny, N. J., and the largest hydro-electric plant was the 400,000-hp. plant at the outlet of Lake St. John on the Saguenay River in Quebec. Three steam-electric plants with an initial installation of over 100,000 kw. are under construction, all three of which will have an ultimate capacity of over 600,000 kw., making each of the three greater than the power plant at Muscle Shoals in all except appeal to popular imagination.

Hydro-electric developments during the year have beeen lacking in the spectacular. Muscle Shoals came to an anti-climax with not enough water in the river to permit filling the pond when the first units were ready to start operation. Nevertheless, numerous other plants —and some of them more important than Muscle Shoals in the matter of immediate-power capacity—were put into service or were carried well on towards completion and as a result the total new hydro-electric power in service exceeds 1,000,000 hp.

The unusual developments of the year include a 35,000-hp. impulse turbine operating under an effective head of 1,900 ft. in the Big Creek No. 1 plant of the Southern California Edison Co. This is the largest turbine of this type in operation in this country but

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it soon is to be surpassed by two of 20,000 hp. in the Balch plant of the San Joaquin Light & Power Co. which will operate under a head of 2,243 ft. Similar turbines to operate under a head of 2,450 ft. were built in this country during the year. They were two double-overhung impulse wheels of 40,000 hp. capacity for use in Brazil. The opposite extreme to these high-head plants is found in the Dixon plant of the Illinois Northern Utilities Co. where five 800 hp. propeller type turbines are operating under a head of only 8 ft.

Other important developments were started or are in prospect for 1926. Chief among the latter is another large power plant on the Saguenay River for the great aluminum manufacturing plant which is to be built there, which plant will have an initial installation of three out of twelve ultimate units of 90,000 hp.

Colorado River Problems

NO IMPROVEMENT in the confused state of the Colorado River complex of problems occurred during 1925, but, if anything, confusion increased. The Colorado River compact is still unratified, the Federal Power Commission still holds in suspense all applications for power developments along the Colorado, and the situation in the delta region, with its implications for the great Imperial Valley, is not improved. Last fall the Imperial Irrigation District discharged most of its engineering staff, and thereby deliberately deprived itself of the safeguard of having trained and capable observation of river action as a basis for its work in fighting the flood assaults of the river. The Pescadero diversion is functioning well, and, provided there is skilled engineering administration, men in good position to judge look forward to its continued usefulness for another decade; but the everpresent danger was exemplified by a small levee break along the Bee River during the summer, a break which might have proved of utmost gravity if the flood and antecedent conditions had not been highly favorable to stability. There is danger ahead for the Imperial Valley. But even apart from the question of engineering administration of the present works in the delta country, the safety of the Valley depends on flood reduction and silt detention by storage in the canyons; the year's developments have not changed this conclusion. At the same time, realization of the Boulder Canyon reservoir scheme has not been brought a particle nearer, and a new Swing-Johnson bill which has just been introduced in Congress to bring about the construction of the reservoir faces certain failure. The Senate committee hearings, throughout the affected territory, produced no tangible result except to make more emphatic the opposition of Arizona to the Colorado River compact and to the California claims upon Colorado River water. Some time before this Arizona had again refused to ratify the seven-state compact, and indeed the compact had suffered a setback through the passage of a new ratification resolution by California, this time with reservations attached, so that at present the compact has been ratified by only five states. Two attempts were made by the lower basin states—Arizona, California, and

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Nevada—to work out between themselves a division of the lower basin allotment under the terms of the compact, but without success. The crux of the lower basin difficulty lies in two points: first, that California's present and prospective appropriations consume almost all of the lower basin allotment of 7½ million acre ft. per year, leaving little or nothing for Arizona, and second, that Arizona's desire to collect tribute from all power development in the lower canyon region is not yet in prospect of being gratified. No action has been taken by the State Department, so far as public information goes, toward negotiating a treaty with Mexico concerning mutual rights in the Colorado and Rio Grande. In the absence of a treaty there is danger that any storage reservoir by increasing the low-water flow, would be absorbed by Mexican lands; and this possibility is feared by all the basin states. Constructive action along the Colorado, therefore, seems as far off as a year ago.

Professional Progress

NO OUTSTANDING professional event or condition marked the year. The licensing of engineers seems to be static; it is required in a majority of the states in one form or other but its effect on practice is not yet discernible. There have been one or two instances where the punitive provisions of the law have been evoked where rank violations of professional ethics have been proved and in one case, at least, a newly appointed city engineer who was not licensed has been prevented from taking office. So far, at least, in spite of these instances, the licensing laws have not proved substitutes for that enforcement of ethical principles which the engineering societies have been reluctant to initiate.

There have been some decided movements in the national engineering societies. The American Association of Engineers is in a critical condition. It has gone through serious internal troubles, partly of administrative origin but largely due to certain basic disintegrating tendencies. Another year may show whether it can exist at all. Magnification of the local chapter to the almost complete submergence of the society as a national unit is being sought by a powerful group, within the membership, and through its influence certain local chapters have recently seceded. Yet it is notorious that the local chapters have no more justified their existence by the extent and strength of their local activities in the American Association than they have in the American Society of Civil Engineers, where a similar aggrandizement of the local chapter is being sought. One of the amendments to the constitution now before the Am. Soc. C. E., while ostensibly looking toward a reform of the method of nominating officers, in reality sets up the local chapter as an important factor in the government of the society and lays the foundation for just such a control of society affairs by local groups, through elected representatives, as is now seriously menacing the life of the younger society. The prevalence of this view of the function of the local cannot be estimated until a vote is taken.

The American Society has before it, too, a recent report by a committee of its board which has been considering the future development of the society. The major recommendation of that committee emphasizes the work of the technical division, by encouragement of the formation of new divisions, by monetary aid and by placing in the hands of the divisions the responsibility for initiating and formulating all the technical work of the society. No action has as yet been taken as a result of the recommendations but the technical divisions are multiplying and the prospective work of each is very ambitious. So far, at least, one cannot tell where all this technical division activity is to lead. Most of the divisions are new and youthfully industrious, but their industry has, for the most part, produced mere multiplication of simultaneous sessions at each of which a ridiculously small number of men listen to prepared papers. This conversion of the quarterly meetings of the society into eight-ring circuses is not noticeably an advance in society activity or purpose.

The Business of Contracting

CONTRACTING changed status but slightly during 1925. The issues uppermost a year ago—day-labor competition, reforms in surety bonding practices and association development—still continue to occupy chief attention. Their settlement is generally a little closer, however, because of the year's contracting activities. While activity in both day-labor and contract bonding matters has been largely sound and fury there have been some material accomplishments. In California the law calling for a close accounting of day-labor public work has by amendment during the year been given teeth. In California too the correction of surety bonding practices has taken a long stride in creating a bureau to determine contractor responsibility. At the same time the joint conference on construction practices has pushed the task farther ahead by preparing uniform questionnaires for bidders to fill out and securing their approval by the Association of State Highway Officials. Late in the year bonding conditions in New York State were made the subject of investigation by a commission appointed under the Moreland act. The hearings are not yet concluded but from all indications they will lead to the recommendation of drastic legislation. In road work a strong curb on day-labor construction has been the action of the Bureau of Public Roads in placing a close check on all federal aid operations carried out by force account. The vigorous campaign of the Associated General Contractors to restrict day-labor construction has registered in two noticeable respects: the public is more widely informed of the contentions and public works agencies doing day labor work have been more than formerly put on the defensive. In this respect the power of association activity is apparent. Generally speaking, the organization of contractors has advanced. This is manifested not so much by greatly increased membership as by somewhat better cohesion and direction of effort. The progress, if any, has been small in developing in the membership as a whole conviction of association work as of vital interest. As a business, contracting has experienced a good year. On the whole the business has been on a better footing of price and contractual conditions. The year has witnessed a notable extension of American contracting into foreign fields, particularly in the Southern hemisphere.

Florida as an Engineer Sees It

First of a Series of Articles on the Human and Engineering Significance of the Country's Greatest Land Boom

By Frank C. Wight
Editor, *Engineering News-Record*

I—The Boom Itself

THERE seem to be three kinds of people in the United States today—those who have not been to Florida, those who have been to Florida and merely talk about it, and those who have been and write about it. The latter is such a large and growing class that one has some hesitancy in adding to it, but Florida, having become the conversational high spot of the whole United States, obviously offers the material for writing to one who has been there and particularly one who went there for that specific purpose. Excuse for this particular effort is that so far there seems to have been nothing written from the point of view of the engineer and the contractor who together are contributing about the only solid basis to that astonishing effervescence, the Florida land boom. When the froth which always accompanies effervescence has disappeared, there will be found in Florida a certain residuum of honest progress, and that residuum will be what the engineer and his fellow worker, the contractor, have been responsible for.

Florida is in the midst of the greatest land boom in the history of this country. There have been other booms in the past. Some of them have been over a larger area, as the one which accompanied the opening of the transcontinental railroads. Some of them, especially the southern California development of the last ten years, have borne some resemblance to the Florida case, but none have been so concentrated, so excited, or so uniform over a comparable area as this Florida boom which is now under way. The tentacles of the excitement are spread out over the entire United States. There is hardly a village which has not some representative either buying Florida land or making the southerly pilgrimage. No city can be considered of metropolitan size unless it has on its main street a Florida real estate office. Every newspaper and every magazine in the country carry the advertisements of the Florida realtor. And last but by no means least important, the new musical shows in New York are all set in Florida and the humorous paper which has not gotten out a Florida number or the comic strip artist who has not carried his creatures to those sunny shores is far, far behind the times; there should be no need to emphasize further than that the pervasiveness of the Florida real estate boom in the current interests of the day.

This first article will be the story of the Florida boom as one man saw it in an intensive visit. Except casually it will not emphasize the engineering side: that will be left for later articles. This one will not be statistical or analytical, though it will trespass on the critical. We will hope that our friends in Florida will not consider it a part of that "northern propaganda" which they conjure up to explain anything that is not exactly in tune with their present lyrical mood.

History of Development

Some figures and a little history are necessary to get the picture of the present situation. Discovered in 1512 and settled soon thereafter, Florida is the oldest section of the United States, but its isolation and its sub-tropical régime prevented its development. It became a state in 1845, but, except for the northern section, it remained the most sparsely settled of the eastern states. In 1900, even, it had a population per square mile of only 9.6 as against 25.6 for the United States and even 11.6 for Texas with an area five times as great. Railroad development was slow, Tampa, its great west coast port, being opened to rail only in 1884 and the Florida East Coast Ry., the real initiator of the present Florida boom, not being completed to Miami until 1896. It is a flat state, the whole coastal plain being only a few feet above the ocean and gulf, and the central so-called hills rising to an average of 100 ft. with occasional elevations as high as 240. Two-thirds the way down the state lies Lake Okeechobee, next to Lake Michigan the largest fresh water lake in the confines of the United States, and south of Okeechobee extend the almost impenetrable Everglades.

The climate is tropical and sub-tropical. Below a certain line, about midway down the peninsula, frost has never been known and even the northern section is, with rare exceptions, free from snow and ice. Because of these physical conditions, the state did not respond even as fast as the rest of the Confederacy to the post Civil War development. Certain industries are what one might call native there. It has long been a large producer of naval stores. It has the largest phosphate fields in the country. Because of its proximity to Cuba and the tobacco centers of the West Indies, there early developed a large cigar and tobacco manufacturing industry, though tobacco raising is comparatively small. Taken by and large, however, up to the beginning of the present century it was a moribund state.

With the coming of this century, however, and with the growing prosperity of the country there has developed a class of people who have the combination of time, the inclination, and the money to seek warmer climes in the winter and the Florida winter climate is all that it has been advertised. Slowly, therefore, there developed a series of towns running down the east coast as the East Coast Ry. was built, reaching out from the established center of Tampa on the Gulf, and extending up and down that beautiful ridge and lake country which forms the backbone of the state. By 1910 the

population density per square mile had increased to 13.7 and by 1920 to 17.7 with a population just under a million, but even then it was the most thinly populated state east of the Rocky Mountain area with the exception of Nebraska, and North and South Dakota. In 1920 its density compared with others was as follows: Florida, 17.7; the United States, 35.5; the New England States, 119.4; the Middle Atlantic States, 222.6; the Southern group, 52.0; California, 22.0; and Texas, 17.8.

By 1920, however, the movement toward the state had commenced. Citrus fruit growing in the lake country had become a profitable and extensive pursuit. Winter resorts of elaborate nature had developed on both coasts; and the railroads, still reluctant to extend their lines farther into the state, were every winter taxed beyond capacity to carry the warmth-seeking tourists. It is impossible to trace statistically the growth since 1920 or to put a finger on a definite time when that growth began to change from the normal course of any American community to the dizzy rise which has marked the last two years. No one knows today how many people there are in Florida. To travel through the state gives one plenty of evidence that any accurate census would be impossible. However, a census was undertaken the past fall and the cities, where records are more readily taken, are now in the usual uproar of protest against the too small figures which are announced. It is sufficient to note, however, that Tampa, according to the census, has increased 84 per cent in the last five years; that Miami has increased 141 per cent; Orlando, 140; West Palm Beach, 121; Lakeland, 142; and the state as a whole, 29 per cent, which gives it a population of a million and a quarter.

But the transient nature of the crowds who are pouring into the state makes it impossible to verify any such figures. It is enough to say that all of the larger cities, all of the cities in fact over 5,000, are now teeming with a restless population; that Miami today is without exception the busiest looking city in the United States; that in Miami, in Tampa, in Fort Lauderdale and in dozens of the smaller towns the crowds are milling through the downtown section packed from curb to building line and that automobiles jam the remaining street area. There are 1,500 automobiles an hour running up and down the Dixie Highway, 17,454 foreign cars crossed the bridge in Jacksonville in November and the daily newcomers to the state are undoubtedly nearer ten than five thousand.

As the Airman Views a Few of the New Buildings in Downtown Miami

The darkening of the upper left part of the picture is from the wing of the airplane. The beach is partially shown in the foreground.

All Hail the Realtor!

So much for the growth. How it is now manifested? Mainly, from the superficial standpoint, at least, in the apotheosis of the real estate man. Even Jacksonville, which is far enough north to be removed from the highest temperature of the fever, shows signs of the insanity when one first reaches there. Buses line the streets labeled with the various real estate developments. One can ride free to a dozen of the well-known names that later are to become real as "developments."

Real estate offices line the streets to a degree that seems remarkable to the visitor from the North but that, after travel further south, is conservative.

Going south from Jacksonville over the Florida East Coast Ry. or over the Dixie Highway, which is the only through road extending down the Atlantic Coast, the signs of the fever become more evident. Both sides of the road are lined with real estate developments. Hardly a mile can be passed without seeing that first sign of the realtor's activity, the triumphal arch of some specious kind of architecture under which one must enter the paradise of building lots. Corner stakes dot the land like the bare stumps of a cutover logging operation. Street signs are more numerous than streets. Spanish bungalows become the prevailing blot on the landscape. The farther down the east coast one goes, the worse becomes the congestion of real estate development. To the east among the sand and scrub pine, every so often with insistent regularity appears a "Royal Road," the second manifestation of the realtor's idea of a proper development, and down that road, a clear space of 100 to 200 ft. extending to the bay or ocean, is a vista with colored workmen guiding drag scrapers, innumerable tractors racing hither and yon, steam shovels and concrete mixers, "engineers" behind transits and, far off where the blue Atlantic sparkles, the inevitable hydraulic dredge.

One looks out of the window of the train and he sees a sign "This is the north end of Alcazar City (only that is not the real name) and Alcazar City continues to be noted and described for some 3 or 4 miles along the railroad; a few signs; a number of corner posts indicating that here is the corner of Eucalyptus Ave. and Hibiscus Road; an especially large sign indicating that here is where the East Coast Ry. station is to be built; a secondary sign indicating the site of the post office; a rise of perhaps 20 ft. to the west and a big poster calling attention to Alcazar Heights, and finally a sign "This is the south end of Alcazar City." Seven miles of pine barren, dry after a fashion, low, sandy, just primitive Florida. And some weeks later a two-page advertisement appears in the New York papers announcing that a certain well-known real estate developer has finally been persuaded to take over the development of some Florida land and that after complete investigation of the subject he has found only one place which warrants his expert and responsible direction, and lo and behold, it is Alcazar City that he is advertising!

Farther south you go through West Palm Beach, grown overnight from the backdoor to the aristocratic Palm Beach across Lake Worth to an outflung city of 40,000 or 50,000 people, spotted with bungalows, crowded with automobiles, overrun with buses, a boom town counting hopefully on its permanent future. And then down through that 70 miles of the "Gold Coast."

This "Gold Coast" is the concentrated essence of the Florida boom. Bounded by the ocean and the omnipresent littoral island on the east and on the west by the impenetrable woods and marshes four to five miles away, this little strip is the paradise of the realtor. This is millionaire country, so established years ago by the exclusiveness and expensiveness of Palm Beach. Here, they will tell you, the sun has some specially efficacious rays, sometimes actinic, sometimes ultra-violet, depending upon the literateness of your informant. Here, too, and this is matter of veracious geography, the Gulf Stream swings in to within a mil or two of the shore. It is ideal winter country. Ever square foot of it is laid off in building lots; a quarte of the population of the country could be housed upo them without crowding. And one motors through i with growing wonder at the credulity of man, int Miami, the insane asylum of America.

Miami, the "Wonder City"

The solid development of Miami and its environs is treated elsewhere. This particular description and passage are merely interpretative, for until one has seen Miami in the winter of 1925-26 one has never seen a real estate boom in its prime. Miami, with a population of 1,681 in 1900 grown to 29,000 in 1920, reported in the 1925 Florida census, much to the disgust of its inhabitants, as 71,419, claimed by its "natives" to have a permanent population of 125,000 and, if observation and experience in other cities is any criterion, with a transient population bringing the total to nearly twice that amount. Miami, the "wonder city," one of the early termini of the Florida East Coast Ry. on a sand flat, rarely rising more than 10 ft. above Biscayne Bay, in the heart of tropical Florida, with the beautiful turquoise ocean rippling to its coast, bounded with palms and pines, a little city grown overnight into a metropolis, its narrow streets much too small even for its pedestrians and clogged entirely by its overflowing motor traffic. Books almost could be written on its human elements, on its newspapers, one of them now proudly boasting the largest volume of advertising in the United States bar none, on its fourteen or fifteen steel and concrete frames now rising from fourteen to twenty stories above the street, on its new deep-water harbor, and on its extension gradually toward the Everglades through the continuing addition of suburbs and satellite cities. Its present status can no better be described than in one brief note. Flagler St., the artery of the downtown section, extends for some seven blocks from the bay to the railroad, and those seven cross streets extend a block or two either side, say twenty squares of business buildings. In those twenty squares today there are probably not twenty first-floor street stores devoted to the sale of merchandise! Everything else is real estate offices. Block after block of real estate offices, little offices with a lone desk crowded into what had been a stairway hall; grand, elaborate Spanish patios open to the street except for massive two-story doors that swing back like a castle gate for one of Douglas Fairbanks' movies. Stores have been shoved back by the realtor's exorbitant up-bidding of leaseholds into arcades cut through from block to block. The main business of Miami today is buying and selling real estate. To sleep one pays a king's ransom and to eat one stands in half-block long queues.

In December it was reported that there were 12,000 people in the real estate offices in the city. They crowded these downtown stores; desk after desk was lined along the walls under blueprints and maps and lovely views of Venetian Canals and palm trees. It was as much as one could do to walk the streets. The buttonholing second-hand clothes dealer could have taken lessons from the Miami realtor of last summer. Then the city officials, who are honestly struggling with what in their confidential moods even they will admit to be a mystery, stopped that. They won't let a man

come out and talk to any one who is walking peaceably on his business in the street, but the realtors stand in the doors and hand out circulars and they find prospects for every desk has one of them sitting looking at the gorgeous pictures of palms and ocean and listening to the more gorgeous stories of thousands made overnight.

Across the State

From Miami one cannot cross the peninsula to the west. The state is surveying the Tamiami Trail which does shoot due west, but the road itself has only gone a few miles into the jungle that lies beyond. The surveyors have been through and the road will soon follow. Now, however, one has to go north to West Palm Beach and take the Conners Highway to Lake Okeechobee and from there by some of the finest roads in the United States, built by the state, north and west to the Gulf. Traveling the Conners Highway is an experience. The shrewd old Buffalonian who built this toll road knew what he was about and while he may not get back his money on tolls—though even that is possible—he will surely get it back many fold in selling as square feet the square miles along his highway that he bought at acreage prices. Straight through the upper edge of the Everglades it goes, miles almost without end, it seems, with no sign of life except a stray coon or the skittering rattlesnake. And the realtor is even here; we were admiring one of his signs advising us that the morass and woods we saw could be bought in lots as a part of a development we remembered from Flagler St., when an alligator altogether too long for tenderfoot composure grandly paddled along about thirty feet from the shore like a semi-submerged submarine! West one goes from here, north and west, through the pleasant hills and lakes of the "Ridge," to the more temperate West Coast.

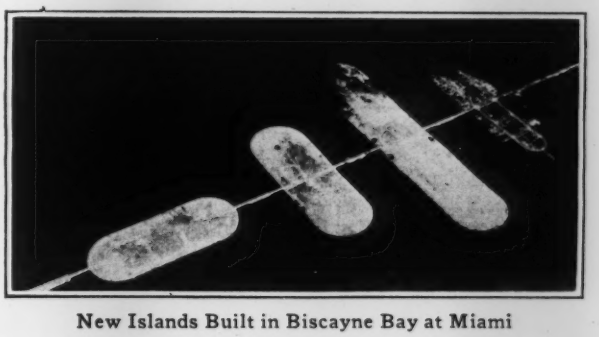
So far, fortunately, the fever has not extended across the state to any such degree as it is manifest on the Gold Coast. Tampa is bad. Already the real estate agents are beginning to outbid the honest merchant for the first-floor areas of that city. Already the hotel lobbies are almost impenetrable masses of shifty-eyed individuals whose whole talk is of real estate profits, but, after Miami, Tampa is peaceful. As one goes south to St. Petersburg and Clearwater and Belleair and to the newer towns of Sarasota and Fort Myers, one finds what is a fairly normal manifestation of the real estate boom. This does not mean normal according to the standards of an ordinary community, but it is a relief after the hectic atmosphere of the east coast.

The center of the state is still more hopeful. Here every so often the lovely orange groves are being cut up into building lots and the triumphal arch erected, glorifying some realtor, but by and large the development is sane, for Florida, as possibly one would not think after reading the preceding paragraphs, has real merit and that merit is being appreciated more by those who can make it solid and honest in the center of the state than it is on either coast. The towns one passes through are well established; their homes look normal and permanent; so far the blight of Spanish architecture has not become predominant. The farms are broad and prosperous, the citrus groves beautiful and, unless marketing is an unknown art, they must be profitable. Sebring, Ocala, Lake Wales, Lakeland, Orlando and a dozen others are prosperous with a permanent prosperity that will continue just so long as they can keep away the pernicious speculator and developer.

A Typical Development

No one has attempted to record the number of real estate developments that are under way in Florida. They must run into the thousands, varying from the enormous and expensive developments such as Coral Gables and Boca Raton, down to the fly-by-night operations of some shyster real estate man who buys a couple of acres and divides them into a few dozen lots. They extend from the beautiful shores of the Atlantic to the jungles around Lake Okeechobee. They pre-empt orange groves and they borrow from the ocean. Acreage is what the operator is now seeking and has sought for some months in Florida, acreage which can be bought at figures varying from $10 to a couple of thousand dollars per acre and sold at $500 to $50,000 a lot. Turning big ones into little ones used to be the slang phrase for the stone-pile operations of the convict camp. It is the slogan of the Florida real estate operator today.

In one respect, however, the real estate development there is different from anything that has ever gone on in this country before, even remembering the somewhat similar development of the country south of Los Angeles four or five years ago. That is in the immense amount of capital that is being poured into the larger developments. Millions of dollars are being handled where thousands were handled in other booms. Instead of the casual development with little labor, we find



New Islands Built in Biscayne Bay at Miami

the counterpart of the enormous cantonment or war construction operations of 1917. In fact, a trip through Florida today recalls inevitably the atmosphere of the summer of 1917. Money is of minor consequence. A thousand dollars is as nothing. The thing to do is to get the work done. Machinery is bought lavishly. Men are used inefficiently.

It may be well to visualize what one of the big operations on the east coast means. This description will apply to any one of a half a dozen, so it need not be named. We will assume first that the operator has bought an area of several thousand acres, in that flat, wet strip that lies east of the jungles which range around 5 to 10 miles back from the coast line. Along this shore is a sandy strip of land, an island or possibly connected at one end with the mainland, and a bay a quarter mile or so wide, and then the mangrove swamps and the pine barrens. A mile or so back from the shore run the railroad and the Dixie Highway. Into this area the operator pours his money and his men

First, he cuts through this his 100 or 200-ft. road from the highway to the sea, and at the Dixie Highway end he erects an administration building and possibly a small hotel. Then comes the clearing squad. At a cost of $90 to $100 an acre they clear out the brush, cut down the trees, drive out the alligators and rattlesnakes. Meanwhile, down at the ocean front a series of dredges are at work. First comes a steam shovel or a clamshell working from the mainland out, digging drainage ditches 30 to 50 ft. wide and piling the spoil up on the sides to form levees behind which the sand spoil of the hydraulic is poured. The ground is drained and being drained naturally sinks some distance, but is brought back to a usable elevation by the sand fill. The drainage ditches become Venetian Canals, crossed at intervals by concrete bridges tying up the property into one community laid out by a city planner to accommodate residences, golf clubs, hotels, and in some hopeful cases, industries. Down at the shore new land may be made on the bay by building concrete wall bulkheads some distance out from the marshy shore line and filling from the dredged channel of the bay. Finally, on the sand strip coast where property is priced at from $1,000 to $2,000 per front foot, is laid out the major hotel with possibly a boardwalk and accompanying casinos and bathhouses, etc., and villa sites for the wealthy. When it is all done, there is a potential community established capable of housing thousands of people permanently and caring for thousands more transients who seek their winter pleasure. Millions of dollars, sometimes fifteen or twenty, have been poured into such single developments.

Turning a Florida Sand Barren into a Residential Community

In other places, notably at Tampa, St. Augustine and Miami, new land is being made in the bay. This is one of the distinguishing phenomena of the Florida development. Miami has an early history of this development, for the initial contribution to the growth of that so-called "wonder city" was the turning of Miami Beach, a sand barren, into one of the play spots of the Western world, and in connecting this island, no longer a sand barren but a majestic, heavily wooded park, filled with hotels, golf courses, polo fields and residences, to the mainland with a causeway 4 miles long. The major part of this causeway is sand fill, pumped up from the bay bottom, and extending out from it, like the flippers on an oldfashioned kite tail, are islands built up wholly from the sand of the bay. These islands are miles long and a quarter of a mile wide in places, and those built four years ago look now as though they had been there since prehistoric times, for the palm tree is readily transplanted and foliage grows luxuriantly in this climate.

What the Engineer Contributes

Another article of this series will have to be devoted to the details of the engineering and construction work in Florida, but this preliminary story would not be complete without a reference to how much the designer and constructor are contributing to the real development of the state. As has been said, the distinguishing feature of the general real estate development is the amount of money that is being spent. This is a real contribution to the upbuilding of the state, for it is going into permanent structures and permanent improvements. A trip through the state, for instance, leads one almost to believe that all the dredges in the country are concentrated south of Jacksonville. One can hardly look around without seeing somewhere in the offing, and the horizon is always a long distance away in Florida, a dredge or a steam shovel gradually turning wet land into dry or ocean into terra firma.

Bridge building is a major activity. These bridges range from the long fill and concrete causeway, such as the 5½-mile Gandy bridge connecting Tampa to St. Petersburg, and the 4-mile Venetian Isles causeway just completed at Miami, to the small crossings of the drainage ditches wherever wet land is being turned into lots. The major structures are well done. The design is adequate and the construction in competent hands. Some of the minor bridges are equally effective, but one sees some things that do not augur well for the future. Somewhere near Palm Beach, for instance, may be found so-called lath concrete bridges, where reinforcing of the ordinary plaster variety of lath left embedded in the concrete was used as an outer form to be plastered over for the beautiful stucco surface. Such bridges are anything but permanent and the material and construction methods those of the real estate developer not of the engineer.

Similar criticism may be made of the general engi-

neering work, but the details must be left for the article on that subject. As would be expected, there are good and bad engineers in Florida and good and bad contractors, but the harvest of the bad ones will be undoubtedly disastrous.

The development of the cities, too, is interesting and warrants further treatment. When a town grows from 2,000 to 25,000 or 40,000 as Fort Lauderdale has, or from 25,000 to 150,000 as Miami has, the city services are seriously overloaded and the work of bringing them to date is a major operation which requires the most intelligent engineering skill. Fortunately, the citizens of these cities recognize the necessity for expert aid and generally speaking the engineers who are engaged in this work are of the best the country affords and the work that they are doing admirable in every respect. They are hampered by difficulties incident to the occasion, but with that exception what they are doing would rank with the best of similar city work under normal conditions.

With all the money being spent there, too, one might imagine it a paradise for contractors, but they will tell you different. A contractor who would go down now would be a bold man. It is a job for the experienced. Housing conditions are terrible and labor is dissatisfied on this account, no matter how much money it gets. Material is practically impossible to get. Late last fall an embargo was laid on the railroad entry into Florida. Since that time, practically no material has entered via rail except foodstuffs and such other absolute necessities on which permits from the railroads could be obtained. The material, therefore, which is now being put into construction is coming mostly by water, which means that it is landing in the one or two ports which Florida now affords.

The Basis of the Boom

So much for the outward evidences of the boom. What real basis has it, if any? Volumes have been written by Florida people and by the various newspaper and magazine men justifying the basic value of Florida. It will not be necessary or desirable in this kind of an article to elaborate these claims. It can be said, however, that there is ample reason for an increase in value of Florida real estate and an influx of population. This is based on two things: the agricultural possibilities of the country and its undoubted attraction to a certain class on account of its climate.

The soil of Florida for a large part is very prolific. Anything almost can be raised on it except grain, and the crops are rapid growing and frequent of harvest. Vegetables and fruits particularly flourish and they come to fruition at a period when the rest of the country is without these necessities or luxuries. Livestock, dairy and agricultural possibilities of the state are also very great. So far, the surface has only been scratched in this development and in the present excitement, while agriculture is much discussed, very little new capital is going into it. As long as more money can be made by selling land than by cultivating it, farming is not an attractive enterprise. There will, therefore, have to come some kind of slump in Florida before agriculture commences to take its proper place in the development of the state.

Industrial development of the state is not promising. For industry is required a supply of raw material and a supply of labor as well as a prospective market and proper transportation. There is little raw material in Florida except wood products and fertilizer. Labor will possibly come. The climate may attract a sufficient number of men who are anxious to enjoy its winter advantages and who can put up with its summer disadvantages. Markets depend entirely upon proper transportation, and that still remains a problem of the future. The railroad and harbor situation today is far from satisfactory, but, as is discussed later in this series, there are developments which promise much.

Rudiments of a Street in a Florida Development

There remains then the climate. More and more people are becoming sufficiently possessed of those three necessities—the time, the inclination, and the money—to spend a certain part of the year in the equable climate of Florida. More and more there are who probably have sufficient so that while not being able to maintain two homes, they can get together enough capital to spend their remaining days in comparative leisure, and to them Florida offers a desirable home. These, however, are intangibles. That they exist the present Florida boom shows, but to what extent they can develop it is impossible to predict. Certainly, the present situation there is not a fair measure of the future, for so many of the people who are now flocking to Florida are coming in search of the easy profits of land turnover that one cannot assume that any given percentage of them are honestly led by the desire for the permanent attractions that Florida offers.

As a guess I would say that 90 per cent of the people who are buying real estate in Florida today are buying it with the expectation of selling it to some one else. There must be a great number who are really going to make it their permanent or occasional home, but one rarely comes in contact with them. Every one has some property that he wants to sell. The stories that one hears everywhere of the tremendous profits that have been made in Florida real estate are no doubt true. Prices have increased miraculously. There is no good to repeating the stories one hears. Any one can make up his own story of increase of value and he would in his wildest imagination not be able to cap the biggest stories one hears. Most of the people, therefore, in my opinion, are there with the idea of making money out of some one else. All of the earmarks of speculation are present, and, in spite of all argument on the

solid basis of the Florida boom, one comes back to the very evident fact that prices are far above values in the major part of the state and that until those prices commence to come down to somewhere near value, the speculative movement will be supreme.

The Bursting Bubble?

When is the bubble going to burst? That is the question everyone is asking. First, of course, that presupposes that the Florida boom is a bubble. If it is, it is bound to burst, for that is the end of all bubbles. Is the Florida boom a bubble? Most certainly a large part of it is if one may make so inaccurate a physical comparison. And that means that it is obviously going to burst. Few of those who write on the Florida development have the courage to set a time when this explosion is going to take place. This is but natural. The general opinion of every one who has not been to Florida is that it is overrated and overextended; that the conditions there today are merely acute examples of the speculative craze that is sweeping the whole country and that the normal course of speculation is downward after a short period of rise. One has only to go there, to see the thousands of eager visitors, to wander around acres of wilderness being turned into pleasure resorts and towns, to read the miraculous records of bank clearings and deposits—to realize why the average writer is reluctant to condemn everything there and more reluctant to set a time when a change will come.

The very obvious fact is that thousands and thousands of people are going there and spending money. I stood one day on the Dixie Highway near Fort Lauderdale to check the figures that I had heard about. I took a traffic count in the limited time that was at my disposal. I proved to my own satisfaction that the stories that are printed are true; that 1,500 to 1,800 cars an hour are passing up and down that busy road, and at the same time a real estate man who was standing near me told me that that morning he had checked up the cars that went up and down the Dixie and had up to one o'clock found a license plate from every state in the Union except North Dakota. All of these people are coming to Florida because there is something there they want. It may be that that thing in many cases is the craze for easy money, but that craze is in itself bringing about the enormous physical development that is evident everywhere and that physical development is creating values that must in time swerve towards validity.

The curse of Florida today is the real estate promoter, the real estate agent, not the Merricks and the Fishers, but the crowds of their hangers-on who flock the streets of Miami, who get 10 per cent commission on every sale they make and get it in cold cash out of the first payment that is made by the customer. There may be a difference in the morality between making a book on a horse race and selling real estate on a commission in Florida today, but to one observer, at least, that difference is very small. When a six-room bungalow on a 50-ft. lot in an ordinary city street in Miami, which, except for the climate, is neither more or less beautiful than Iowa City or Marietta, Ohio, sells for $37,000, something is radically wrong. Prices may continue to go up, but so did the price of tulips in Holland. The time came, however, when there was a last buyer of tulips and they fell to their intrinsic worth. So will it be with Florida. All the arguments in the world as to the commanding beauties of Florida and its climate will not persuade any one except a local real estate agent that the present values there can persist. Miami, Tampa, St. Petersburg, Fort Lauderdale, where similar so-called values are prevalent, cannot compete against the rest of the United States on any such disparity as exists. That is so evident that it does not need arguing. Although they tell you in Florida that you have to be there a month or so before you get the spirit of the thing, before you really grasp the vision of the place, in telling they forget that possibly the being there more than a month or two does not permit you to gain knowledge so much as it deadens your sense of perspective, that the person who comes and goes away after a short experience of the excitement may be better able to judge values than the one living in the insane atmosphere of a real state boom.

So at the risk of future embarrassment I set down as a matter of considered judgment that the east coast of Florida, at least, from the middle of the state to Miami and beyond, is in for an early and a pronounced deflation. The supply of new money must be nearly at an end. The inflation of prices has reached its absurd limit. The speed of the deflation of the rest of the state depends entirely upon the degree to which the infection of the east coast reaches beyond the Gold Coast area. The center of the state is fairly normal. It is a desirable country. It has prospects of great and solid development. The west coast is not quite so sane, but moderately so, and if it stops now in its mad career it, too, will develop surely. Both, however, will be subject to the Miami infection and if they succumb they, too, are doomed to early disappointment. I have not the courage to try to predict when the boom will break, but break it will, of course, and my guess is that it will come at the end of the current winter season.

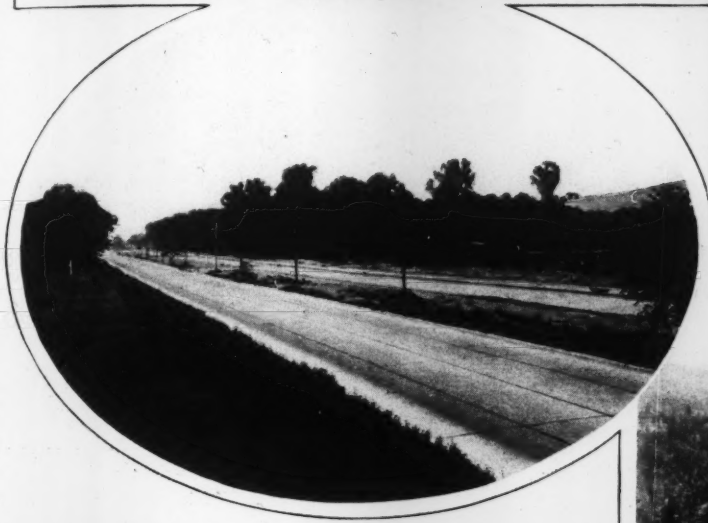
Real Progress Will Be Permanent

The phenomenon of Florida is the intensity of the boom and the wide distribution of those who are taking part in it. There have been other notable land rushes in the United States, but never before has so much responsible capital been enlisted in the development of one section of the country. Just now Florida is a seething whirlpool, from Jacksonville to the Keys. No one operating there is entirely sane. There is a mob psychology at work which destroys individual judgment. But that phase will pass. Prices will come down toward value, some of the big operators will go broke and thousands of smaller so-called investors, who are really speculators, will lose their white chips, and Florida will start again on the solid basis of the enormous physical structure that is now being erected toward its proper development, that is, as the pleasant home—mainly part time—of those fairly limited few who can afford it, and the permanent home of a sufficient number of agriculturists who have capital and industry enough to make farming a business. Its industrial development has less promise than the rest of the South and the permanent residents outside of the farmers and the valetudinarians who seek the sun and warmth, will for many years be made up of those who cater to the daily needs of the rest.

And this is an almost unbelievably hopeful destiny when one thinks what Florida was only a decade ago, however far it may fall below the dreams of the speculator or the mirage of the realtor.

PROGRESS IN CONSTRUCTION *in 1925*

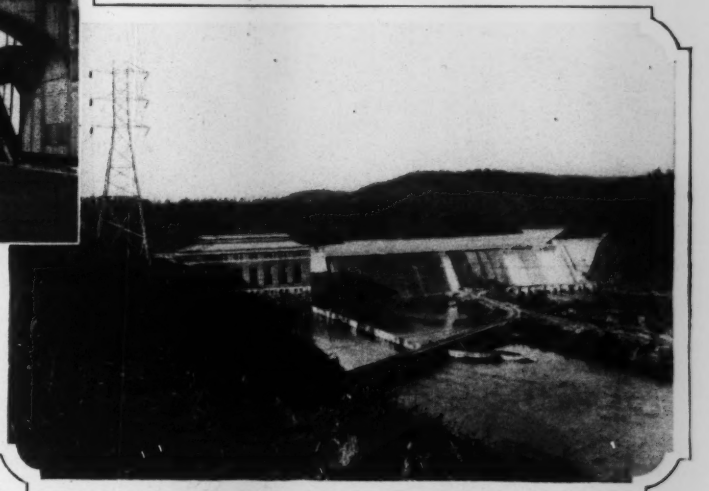
Gilboa Dam, New York City water supply



Super-highway, Detroit-Pontiac, Mich. Two 40-ft. roadways with space between for rapid transit lines.

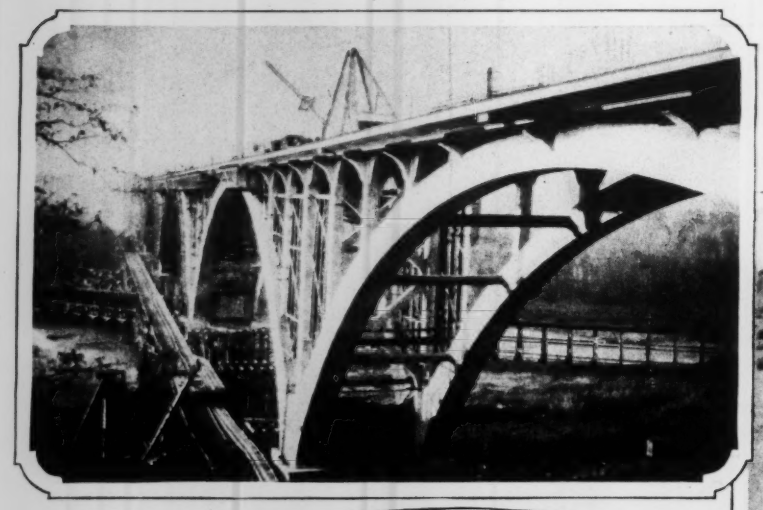
Old and new tunnels on the Southern Pacific double-tracking between Emigrant Gap and Summit, Calif.

Philadelphia-Camden bridge over the Delaware River. Roadway looking west from Camden Tower.

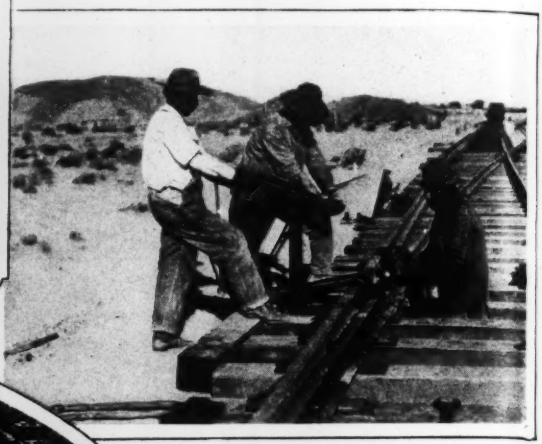


Yonah Power Development, Georgia. The lower of six plants of the Georgia Railway and Power Co. for the complete development of a portion of the Tallulah River.

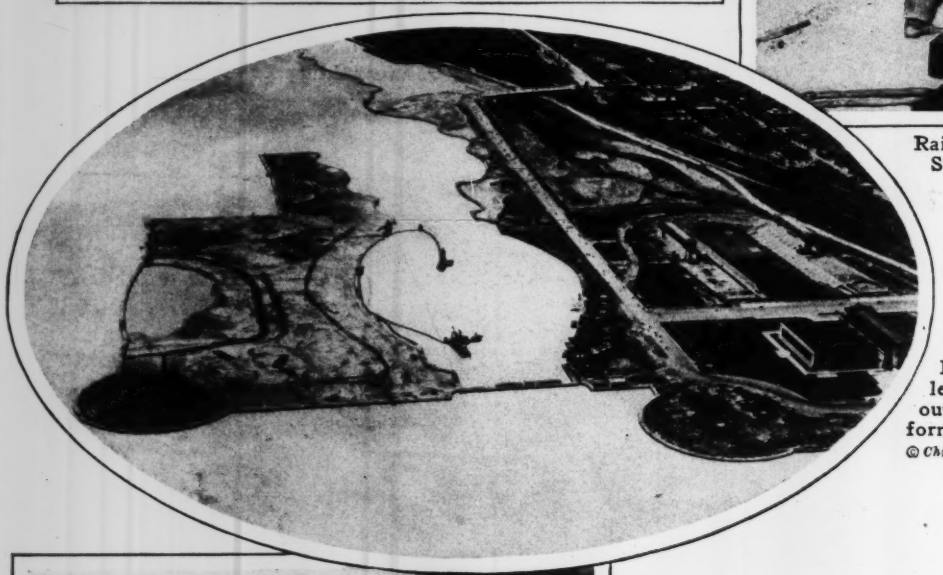
Progress in Construction in 1925



Fort Snelling-Mendota bridge, Minn.
Mendota end, first and second arches completed; third, fourth and fifth arches under construction.



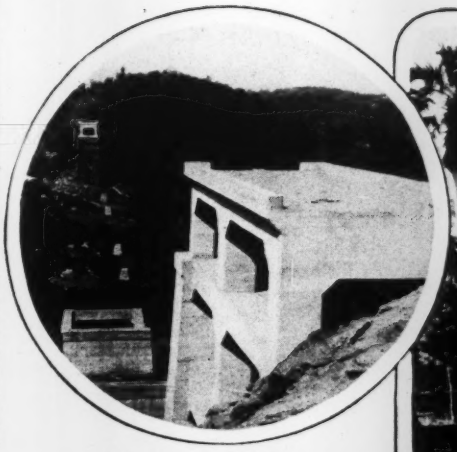
Railway construction in the desert.
Southern Pacific new main line in Arizona.



Start of the South Lake Shore Improvement at Chicago. At the left, beginning of hydraulic fill for outer portion of Lake-Front Park to form ornamental lagoon.
© Chicago Aerial Survey Co.

Highway construction by railroad methods.
Grading on the California state highway at Black Point near Ventura, Calif.

Market Street Vehicular Subway, San Francisco.
Traffic congestion relieved by a short vehicular subway at a busy street intersection.



Hatchet Creek viaduct,
Central of Georgia Ry.

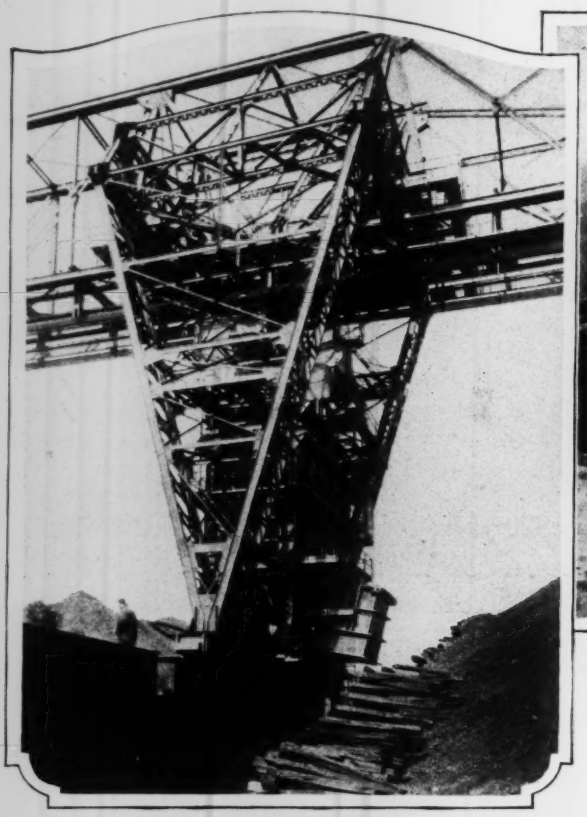
Typical state highway construction in Florida.
Bituminous macadam with sodded shoulders.

Belt conveyors used to build a dam; Wanaque Dam.
North Jersey District Water Supply Commission.

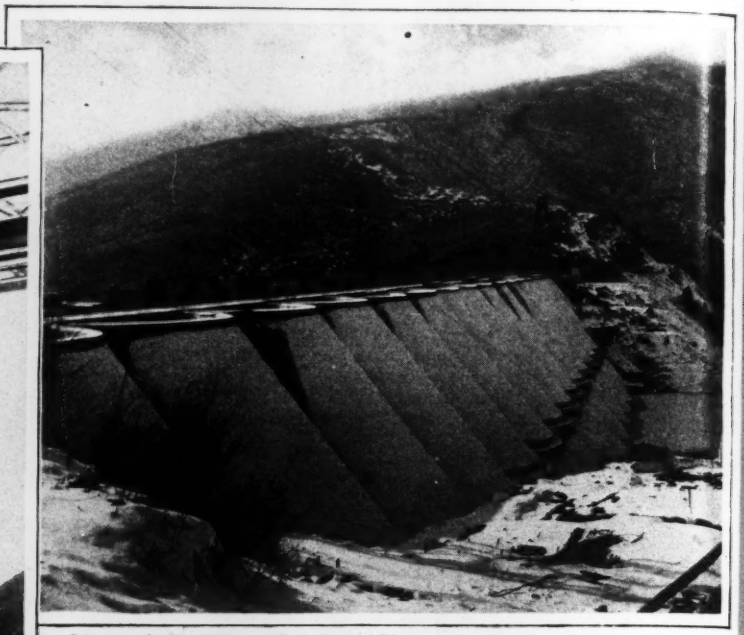
American Falls
Dam, Idaho.
U. S. Bureau of
Reclamation.

Preliminary settling basins, water purification plant,
Kansas City, Mo.

Progress in Construction in 1925

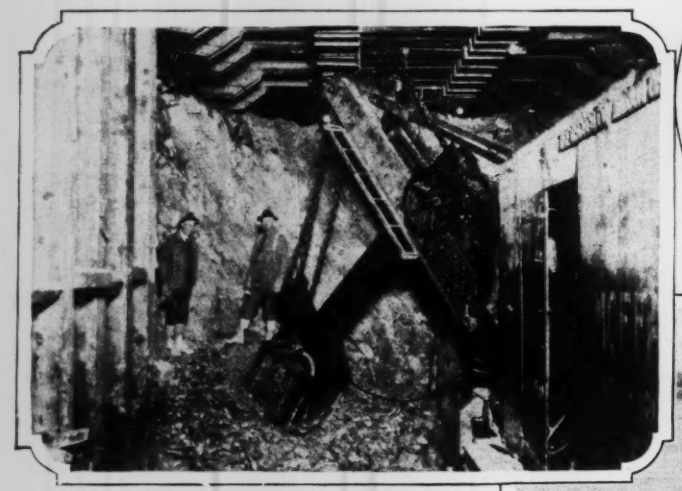


One tower of ore bridge, Ashtabula Harbor, Ohio.

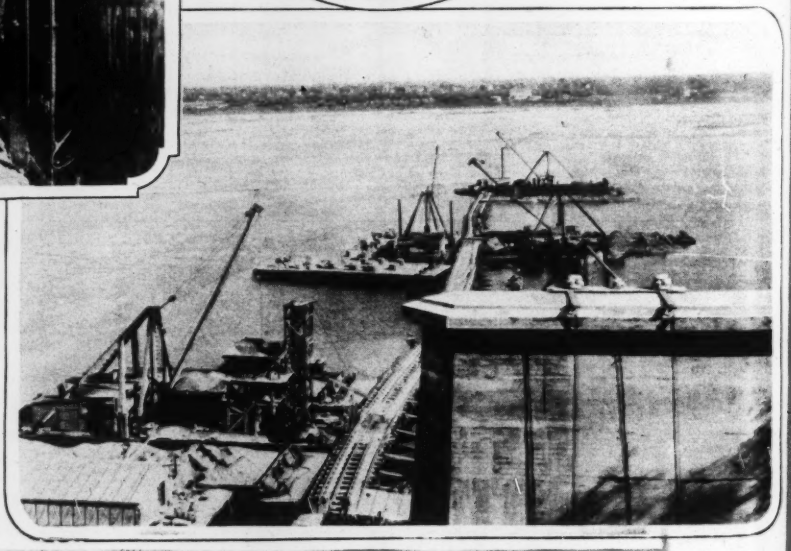


Mountain Dell Dam, Salt Lake City water supply. Crest raised 40 ft. Platforms on face show top of original structure.

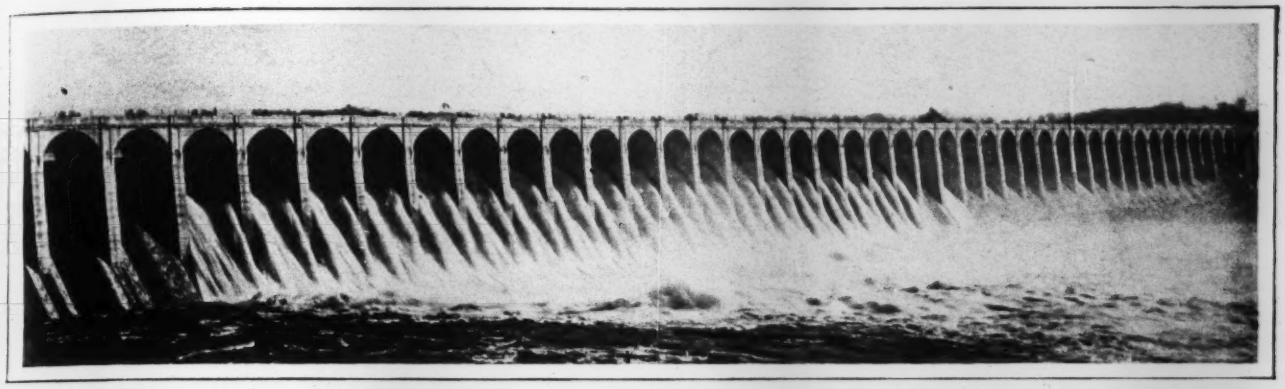
Largest diameter wood-stave pipe in the world. 16-ft. diam. pipe, Copco No. 2 plant, California-Oregon Power Co.



Moffat Tunnel, Colo. Excavating to full section. Traveling cantilever needle-bar in top heading supports wall plates and roof timbers while a 1-cu.yd. air shovel excavates 16-ft. bench.



Montreal-South Shore Bridge, looking across the St. Lawrence River from St. Helen's Island. South abutment in the distance.



Completed spillway—Muscle Shoals hydro-electric power development.

Largest activated sludge plant in the world. Sewage of 800,000 people will be given 100 per cent treatment at this plant under construction at Chicago.

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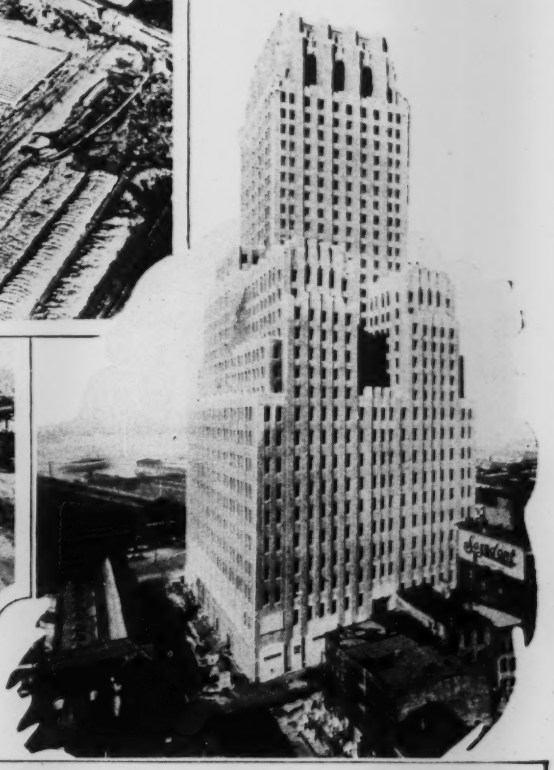
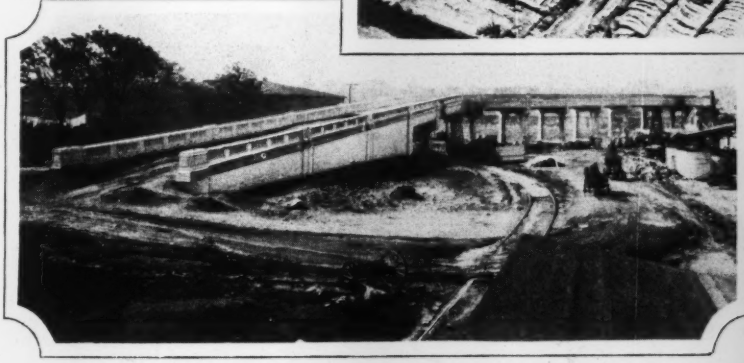
New York Telephone Co. Building, New York City, occupying a whole block and having arcades for walks of the narrow side streets



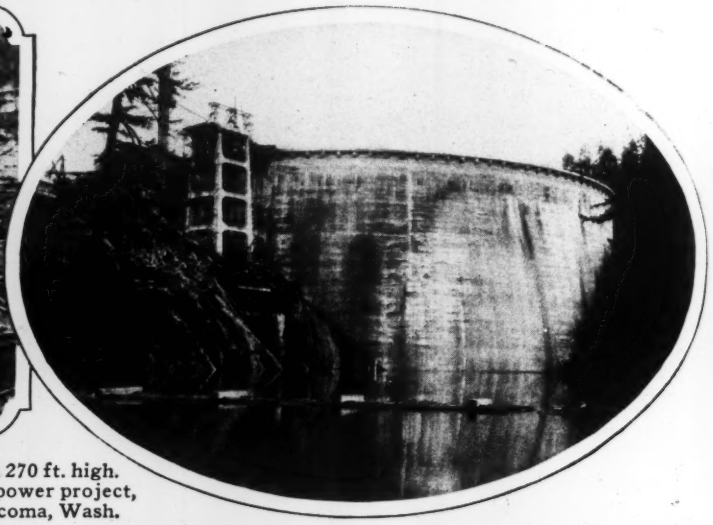


Grade separation work of Norfolk & Western Ry. and the Atlantic Coast Lines at Petersburg, Va.

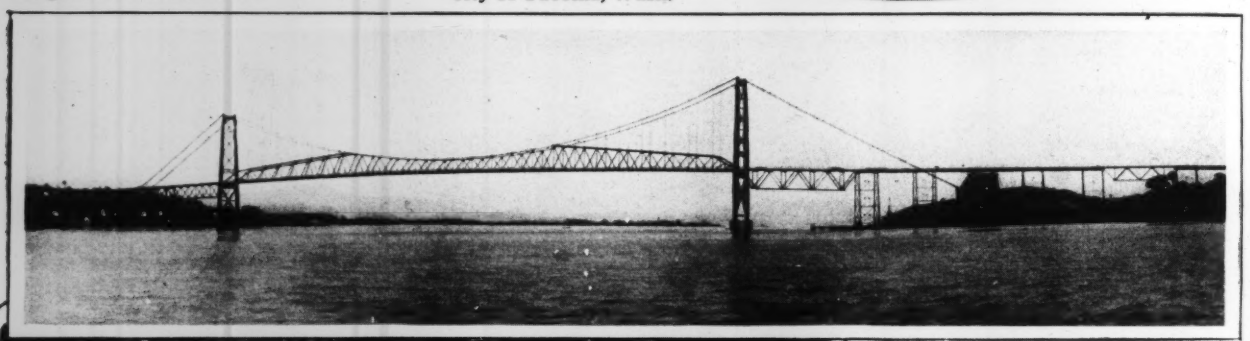
New plant and model village, Beacon Mfg. Co., Swannanoa, N. C.

Progress in Construction in 1925

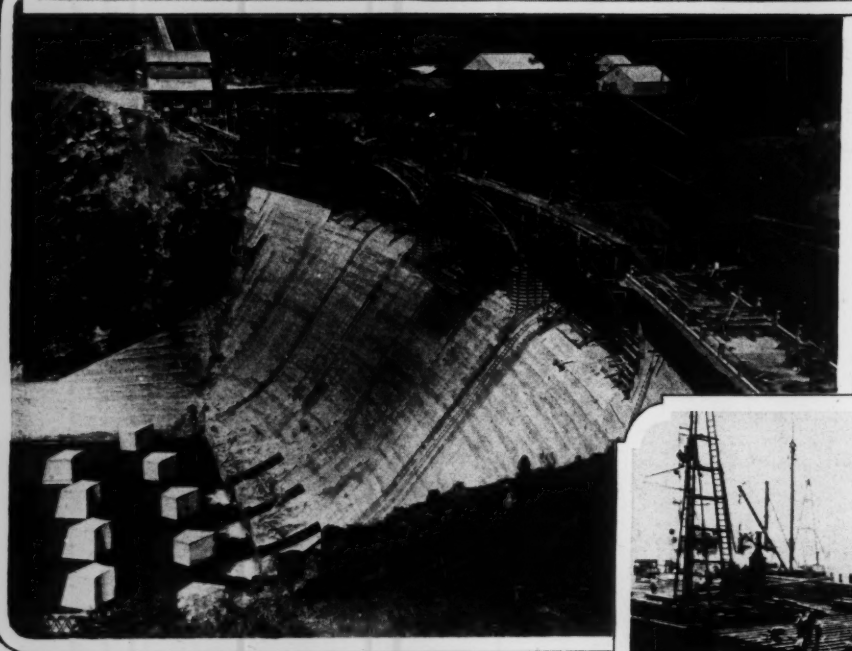
Rock cut and temporary trestle, Illinois Central R.R., Edgewood-Fulton Line.



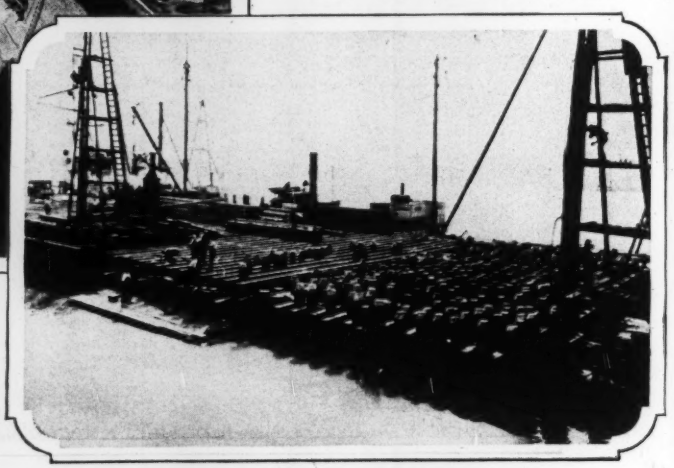
Arch Dam 270 ft. high. Cushman power project, city of Tacoma, Wash.



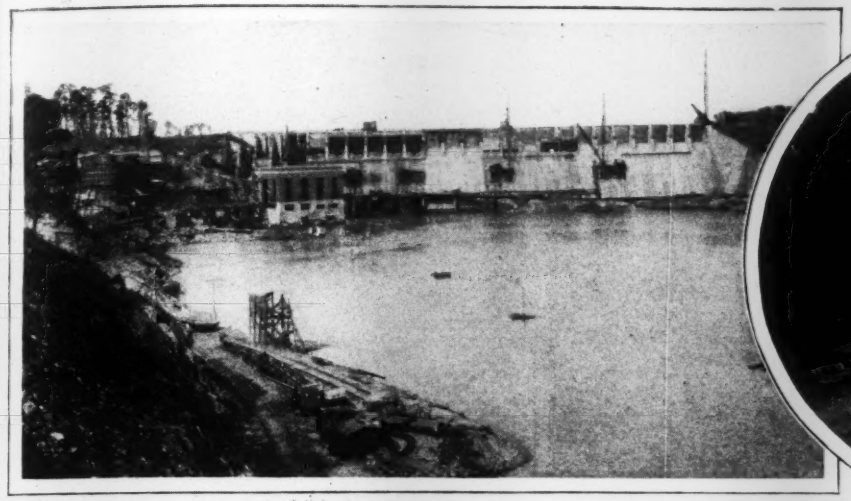
World's largest chain suspension bridge: 1,114-ft. span suspension bridge at Florianopolis, Brazil, recently completed.



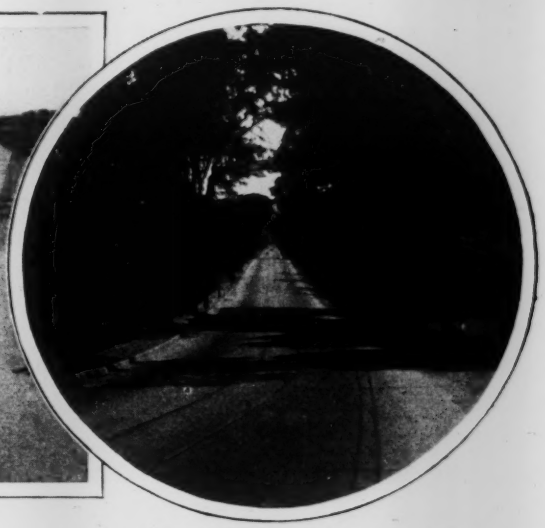
Dense piling in foundations for the new plant of the Mystic Iron Works, Everett, Mass.



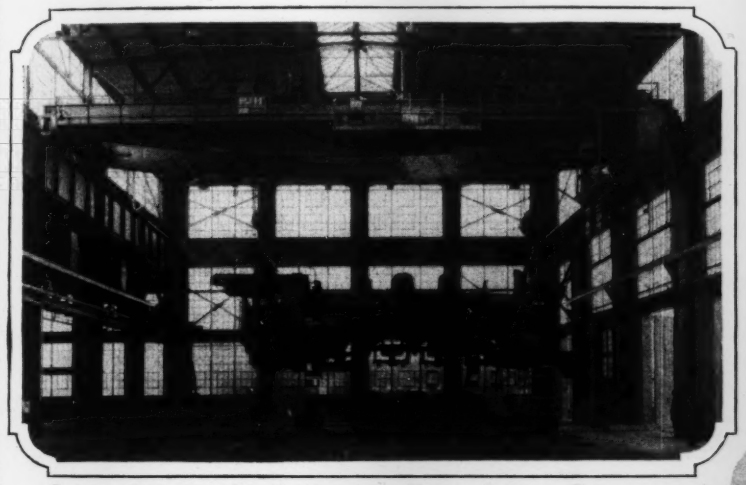
Dam built on volcanic formation. Pit River No. 3 power development, Pacific Gas & Electric Co., Calif. Baffle piers at the toe of the dam to dispel energy of overflow water.



Bartletts Ferry hydro-electric development, Columbus Electric & Power Co., near Columbus, Ga.

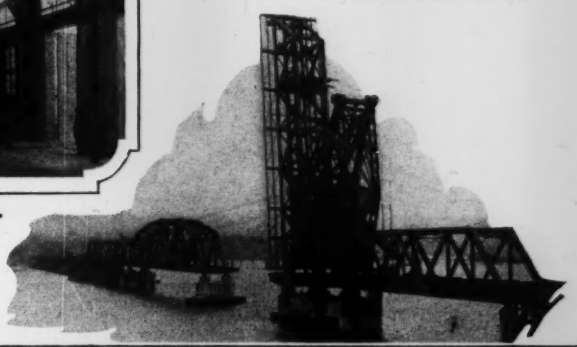


Widened Boston Post Road between New York state line and New Haven, Conn. A 36-ft. paved roadway for four lanes of traffic.



Locomotive shop for the Southern Ry. at Atlanta, Ga.

Combined highway and railway bridge over Burrard Inlet, Vancouver, B. C. Channel piers carried to a depth of 106 ft. below water level.



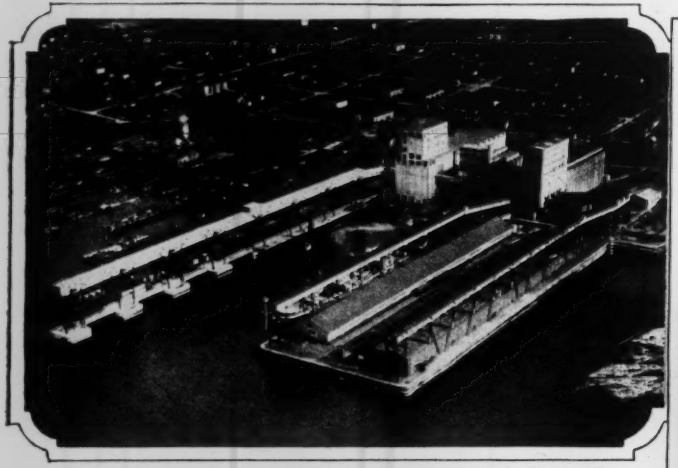
Guernsey Dam, U. S. Bureau of Reclamation, North Platte River, Wyo. A 100-ft. high rock and gravel fill dam with clay core wall.

One of the navigation dams on Ohio River being built by U. S. Engineer Corps.

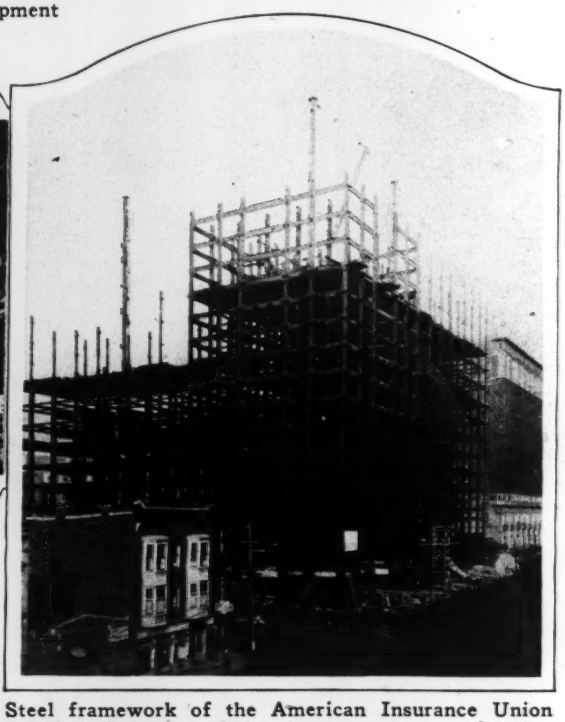
Progress in Construction in 1925

Spillway and power house Isle Maligne plant, Quebec Development Co., on the Saguenay River: initial installation of 400,000 hp.

New York subway system being extended into Flushing.

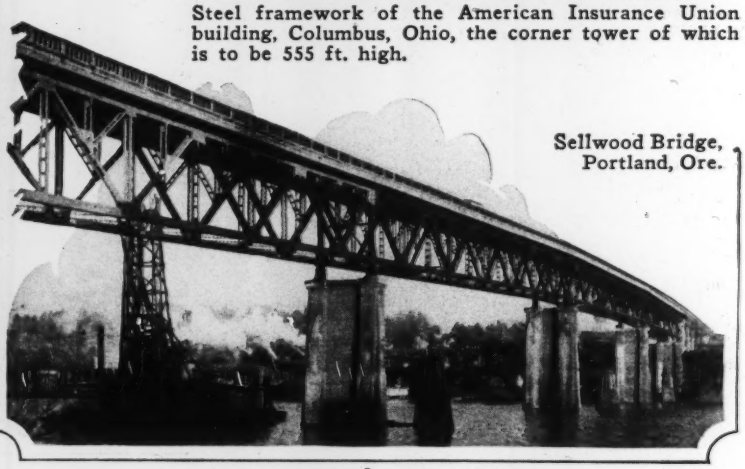


New grain jetty of the Vancouver Terminal Grain Co., Vancouver, B. C., at the left.



Steel framework of the American Insurance Union building, Columbus, Ohio, the corner tower of which is to be 555 ft. high.

Rock foundation work, basement of the 36th St.-37th St. Arcade building, New York.



Sellwood Bridge, Portland, Ore.

Progress in the Study of Engineering Education

Engineering Student Material Is Above Average, but High College Mortality Suggests Improvements in Selection and in Training to Raise Engineering Education to Still Higher Plane

By W. E. Wickenden

Director of Investigation of Engineering Education, Society for the Promotion of Engineering Education, New York City

THE INVESTIGATION which the Society for the Promotion of Engineering Education is conducting under a grant from the Carnegie Corporation is now entering upon its third year. As there were no presuppositions and only vague objectives to start with, the first year was spent in a preliminary reconnaissance and a process of organization. The second year has been a period of evidence gathering, bringing the enterprise to a point where we may begin to diagnose the situation and discover the needed remedies. This leaves the third year available for more constructive effort.

The co-operative method which was foreshadowed in the original plan has been pursued with excellent results. Committees of investigation in one hundred and thirty engineering colleges in all parts of the United States and Canada are participating actively in studies directed by the headquarters staff and five general committees of the society. Important parts have been carried out by the national engineering societies, the U. S. Bureau of Education, a number of prominent industrial organizations and large bodies of engineering alumni. The National Industrial Conference Board has carried out an extended survey of the state of supply and demand with reference to men of higher technical training in the manufacturing industries. A similar survey of the railroad industry is being conducted by the American Railway Engineering Association. It is worthy of note that the work done by the colleges with their own resources has fully matched, hour for hour and dollar for dollar, all the work financed by the Carnegie grant.

As the fruit of these studies there is now available such a body of fact and opinion as has never before been gathered for the appraisal and recasting of any of the broader divisions of our higher education. In the limited space available it is possible only to suggest the scope and character of this material.

Extent and Cost of Engineering Education

It will surprise many to learn that there are 166 degree-granting colleges offering complete engineering courses in the United States and Canada. Of this group 15 are independent polytechnic institutes, 53 are associated with independent or sectarian colleges or universities, while 98 are under public control. Judged by the composite standard of number of colleges, students enrolled, teachers employed and financial outlay, this is easily the largest division of professional or vocational higher education in America.

The average annual cost per student, exclusive of interest and depreciation on plant, has been found to be as follows in four large groups of these colleges: endowed universities, $582; endowed polytechnic institutes, $551; state universities, $358; and state land-grant colleges, $298. Whether there are corresponding differences in the educational results obtained is an interesting field of speculation. The average investment per engineering student was found to be difficult to segregate in the mixed institutions, but the figure for the polytechnic institutes is $7,854.

These items of cost and investment indicate that the annual direct outlay by the colleges of engineering of the United States is approximately $30,000,000 and that the total investment in the special facilities of engineering education approaches $300,000,000. When considered alone the total expenditure on this entire group of educational studies seems large, but when compared with the operating budgets of the colleges directly concerned it is actually quite small, perhaps one-third of one per cent for the entire three-year period. A very moderate increase in educational efficiency would pay handsome dividends on the investment.

What Kind of Students Are We Getting?

Comparatively few engineering colleges draw students from a wide area. On the average a fourth come from the immediate vicinity of the college and could, or do, live at home. Half come from within a radius of one hundred miles and 80 per cent attend college within their own state. Graduates, on the other hand, migrate widely.

Four out of five engineering students come from public high schools, while one in eight comes by transfer from some other college and one in sixteen comes from a private school. For better or worse engineering education is directly affected by the kind of educational foundations laid by the public high schools. With the immense expansion of secondary education in the past quarter-century there has been a shifting of emphasis from intellectual training to civic training which is creating serious problems for the colleges.

As the product of the secondary schools runs, the engineering colleges are getting a goodly share of the best students. Sixty per cent come from the upper third of their class, 37 per cent from the middle third and only 3 per cent from the lowest third. All but 6 per cent of the engineering colleges admit their students without examination on the credentials of the high schools. While there is little control over the standards of secondary education in such an admission system, it seems plain that the engineering colleges are attracting relatively good students and not poor ones. One-fifth of the students admitted in the fall of 1924 were "conditioned." Many cases thus classified represented deficiencies to be made up rather than inferior records. However, the mortality of conditioned students is appreciably higher than among those with clear entrance records. Some tightening of require-

TABLE I—SHOWING HOW MANY ENGINEERING GRADUATES REMAIN IN ENGINEERING

Engineering Course in College	Per Cent in Same Field	Per Cent in Allied Field	Per Cent in Non-Allied Engineering	Per Cent in Non-Engineering Field
Civil	73 6	2 5	10 1	13 8
Mechanical	58 0	10 5	15 1	16 4
Electrical	56 7	7 3	17 1	18 9
Chemical	47 2	13 9	24 1	14 8
Mining	35 5	15 8	25 0	23 7
Composite of all groups	60 0	7 5	15 4	16 6

ments at this point, especially with regard to mathematics, appears to be in order.

The social, economic and cultural backgrounds of engineering students may be judged from the following records regarding their fathers. The positions of the fathers are, in percentages: owner or proprietor, 42 (including farmers 17); executive or supervisory, 28; workmen and clerks, 13; engineers of various kinds, 4 per cent. Fathers in industrial pursuits include 29 per cent; professional, 16; financial or mercantile, 22. Holders of college or professional degrees among the fathers were 13 per cent; attended college without graduating, 11; high school courses only, graduates 16, less than graduation 62 per cent.

In general engineering students are of substantial origins and backgrounds, better than average scholastic ability and preparation, and of a high degree of social and economic assimilability.

Choice of Career and Educational Program

Students choose to enter engineering college at a relatively early age, 50 per cent forming this decision before the last year of high school, 27 per cent during the senior year and 23 after graduation. The basis of this decision as reported by the students entering college in the fall of 1924 was, in percentages: advice of parents, 14; of teachers, 5; and of others, 6; work done or associations formed, 19; supposed appeal of engineering work, 51; supposed aptitude for engineering, 31; to be able to earn a good living, 27; belief that an engineering course is good preparation for many kinds of work, 24.

Check-ups of the understanding of the scope, content and function of the particular engineering field each student was proposing to enter were made with many freshman groups. The results revealed a surprising lack of acquaintance with the subject and have reinforced the impression that the majority of engineering students choose their program without competent advice or authoritative information. Evidently the engineering profession and the colleges have no small task to perform in the field of vocational information and educational counsel.

Student Mortality and Survival

One advisor of freshmen in the middle west sums up the general situation most graphically in his annual address to the entering class. "Look at the man on your right," he says. "When you come back next year he'll not be here. Now, turn the other way and look at the man on your left. When your commencement day comes he'll not graduate." Taking a broad average of the engineering colleges, of every 100 who enter as freshmen 61 enter the sophomore class after one year, 42 enter the junior class after two years, 34 enter the senior class after three years and 29 graduate in the normal period. Students dropping back one or more years and others entering on advance standing bring up the ratio of graduates to those who enter at all stages to 38 per cent.

It is a striking fact that nearly 60 per cent drop out before they reach the major engineering subjects of the curriculum and may be said never to have had an engineering try-out. During the past fifteen years, coincident with the vast expansion of secondary education, this situation has become worse, lack of ability, preparation and interest is the chief cause.

Considering the facts set forth to show that the human material being dealt with is decidedly above the average, this record of mortality raises a whole series of doubts. Is secondary education an effective preparation? Is the basis of admission sufficiently selective? Is the basis of choice of an educational program by the student intelligent? Are students scholastically capable but deficient in aptitude or interest? Are the underclass students properly handled and taught? Is the four-year goal of a college course too remote for the majority? Should there be a serious engineering try-out in practice, either before admission or at some midpoint in the course? Should there be a curriculum in two stages, each valuable in itself, with a natural stopping point for many in between and the basis of admission to the upper stage much more restricted?

Regarding Graduates

The first concern of the graduate is to find employment. One-quarter of the number obtain their first position through a teacher or other college officer; about one-fifth through the solicitation of employers; one-sixth through work done prior to graduation; one-tenth through family connections; and one-fourteenth through the aid of alumni. Apparently only one-fifth find positions through their own efforts, or through advertisement or agencies. There is no indication of an over-supply of graduates. The industrial surveys indicate that large parts of industry are definitely underrecruited. The starting salaries of today are on a par with those of fifteen years ago, making allowance for differences in the purchasing power of the dollar.

In choosing their first positions graduates are strongly influenced by the line of study pursued in college. Only one in ten takes the only job available, and only one in twenty-five is swayed by the lure of the immediate salary as a primary consideration. Young graduates shift positions quite actively in the first three years. For example, the returns from the class of 1922 indicated that 25 per cent had had three employers, 32 per cent two and 43 per cent one in the first two and a half years after graduation.

The extent to which graduates remain in the field for which they prepared and the extent to which they migrate are indicated by Table I, based on the reports of a large and representative group of alumni. While there is much room for varying interpretation of terms in such classifications, it is significant that only one engineering graduate in six considers that he has definitely wandered from the fold.

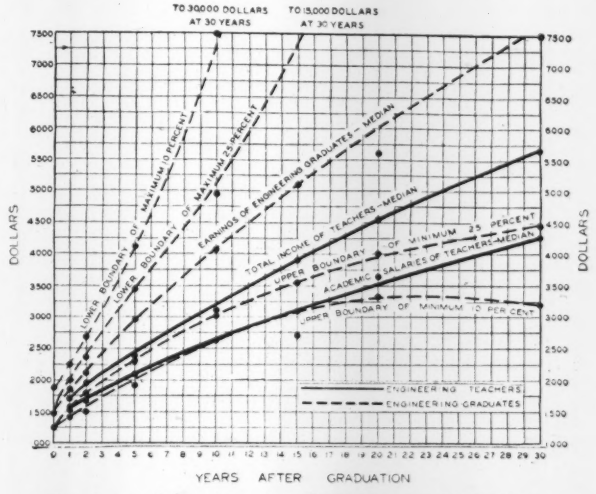
These returns from graduates show a marked trend toward administrative activities during the first fifteen years of experience after graduation. Comparing graduates not yet three years out with those out fifteen

years or more, we find the percentage distributions shown in Table II. Intermediate classes show consistent trends in the direction indicated, with the exception of the sales group, which reaches its maximum of 12.7 with the class of 1919 and thereafter declines.

Earnings of Graduates and Teachers

A larger body of information concerning the earnings of graduates is now available than ever before. The accompanying chart represents the conditions existing in the year 1924 and is based on returns from over 6,000 graduates of forty institutions and from over 2,000 teachers in seventy-five institutions. The three most recent classes of graduates and older classes at five-year intervals were canvassed.

It is worth noting that the median academic salaries of teachers during their first twenty years after graduation closely follow the boundary of the lowest tenth


TO 30,000 DOLLARS AT 30 YEARS
TO 15,000 DOLLARS AT 30 YEARS
LOWER BOUNDARY OF MAXIMUM 10 PERCENT
LOWER BOUNDARY OF MAXIMUM 25 PERCENT
EARNINGS OF ENGINEERING GRADUATES—MEDIAN
TOTAL INCOME OF TEACHERS—MEDIAN
UPPER BOUNDARY OF MINIMUM 25 PERCENT
ACADEMIC SALARIES OF TEACHERS—MEDIAN
LOWER BOUNDARY OF MINIMUM 10 PER CENT
ENGINEERING TEACHERS
ENGINEERING GRADUATES
DOLLARS
YEARS AFTER GRADUATION

Earnings of Engineering Graduates and Teachers

of the graduates, while the total income of teachers which includes the returns from savings and from a modest volume of professional practice agrees with the boundary of the lowest 35 per cent of graduates.

Merits and Defects

The large groups of graduates who have been canvassed, together with large bodies of active engineers and industrialists, have given a significant appraisal of the merits and defects of engineering education. As a means of developing accuracy and thoroughness the rating given is very high; as to diligence, integrity, reliability, initiative and originality it is uniformly moderately high; while as to the qualities of leadership it is moderately low. The technical and scientific preparation is rated as good in relation to the requirements of practice. The cultural content is rated in the range from justified to indispensable by all but one-seventh of the graduates. More than half identify economic and business subjects as the most important omission one-fourth designate English under this head.

In their recommendations for improvement, one-sixth of the graduates put more business training first, another sixth more practical training, another sixth suggest the lengthening of all courses, and another sixth ask for more or better cultural work. One-eighth suggest less specialization and one-sixteenth more or better teaching of the sciences. Less than 2 per cent suggest more or better teachers as the improvement most needed.

TABLE II—ACTIVITIES OF RECENT AND OF OLDER GRADUATES

Type of Activity	Classes of 1922, 1923 and 1924	Classes of 1909 and Before
Consulting engineering	2 1	8 0
Drafting, estimating and design	28 4	7 9
Construction, operation, testing, etc.	29 3	4 7
Teaching and research	11 4	9 6
Administration and management	8 8	45 8
Sales	6 4	4 7
Clerical, manual and miscellaneous	13 6	3 0
Primarily technical	71 2	30 2
Primarily administrative	28 8	69 8

Regarding Teachers

A survey of the recruitment and losses of engineering teachers revealed far less in-breeding and far lower losses to practice than had been asserted. More than a fifth of all appointments are made by promotion from the local teaching staff and a practically equal number are drawn from the staffs of other colleges. The graduating classes supply less than one-fourth of the appointments. Twenty-eight per cent of the appointments are made directly from practice.

The turn-over in all teaching ranks, apart from retirement and death, reaches a total of 10 per cent per annum, but this total includes transfers between the colleges and the losses to practice amount to less than 7 per cent. These losses come largely from instructors and assistants and are probably less in number rather than greater than they should be.

Conclusions

While valid conclusions can be drawn as to many questions of fact, conclusions as to policy are necessarily tentative at this stage. Judged by the prevailing state of collegiate education in general, the engineering colleges are in a good state of health. They attract a goodly share of the best students, their morale is wholesome and there is no water in their curricula—they are too meaty if anything. These colleges are full, but not overcrowded. The graduates are readily absorbed into practice and industry and enjoy reasonable economic prospects. Teaching ranks are reasonably well filled and stabilized.

Too many students drop out without substantial educational achievement. Admission needs to be made more selective and to be based on more intelligent vocational choices. A better balance needs to be created between the technical and the economic emphasis of the curricula. There is an obvious need of better co-ordination of training in college and after college. Relations between the engineering college and the professional and industrial organizations need to be more intimate and are in the process of becoming so.

If the engineering colleges are content to share the widely prevailing level of collegiate education in general, only incidental improvements may be expected or are needed to maintain their present favorable position. Notable advancement will be possible only by the lifting of engineering education to a plane of effectiveness distinctly above other undergraduate colleges. Such an ambition is both worth while and attainable.

Engineering in the Small City—A Survey

Suggested Improvements in the Administration of Engineering Services in the City under 100,000 Population, Based on an Editorial Study from Coast to Coast

IN THE issue of May 14, 1925, *Engineering News-Record* began publication of a series of editorial studies of engineering work in the small cities. This survey, which is not yet complete, will cover every section of the country. So far the stories of city engineering work in thirty-four cities in twenty-six states have been told, and a number of other small cities have been visited by the editors. In making this study *Engineering News-Record* has attempted to bring into bold relief conditions which, it is felt, varied from an arbitrary ideal, as well as to emphasize features of practice which might prove generally informative and constructive. This investigation has produced a mass of detail. Data secured are from cities of varying sizes up to 100,000 population, of every general form of political structure, and of wide divergence in topography and geographical location. Comparison of conditions in the cities surveyed has led to the formulation of principles of engineering practice, which, as nearly as can be determined, fit an ideal situation. Herein *Engineering News-Record* sets forth what it believes to be that ideal. First, a number of outstanding general conditions need consideration.

Three Needs Apparent

Foremost among these it has been found that the position of the engineer in the government structure is, more often than not, belittled. Scarcely ever is the position of city engineer on a parity with that of other administrative officers in the city government. He is appointed by a city manager, a commissioner of public works, a mayor, a council committee (which usually is a single individual), and his tenure of office, like all the other elective and appointive officers of most American cities, is apt to depend upon the success of a particular political party. This condition points to three needs:

1. Education of the public to the necessity for giving engineering and its representatives in the city government their deserved responsible position;
2. Freedom of engineering service from political influence; and
3. Continuity of service for engineers to give to engineers' work greater efficiency in construction, operation and maintenance.

Let it be early understood that we are not concerned here with the city engineer in name. The object of our study is referred to as such but he represents that government officer to whom has been delegated administration of civil engineering affairs.

In this survey it has been found that engineers, proved competent in the beginning of their tenure of office, have frequently been retained through successive complete changes in the political character of the city administration. But rarely is there any assurance of either competent or continuous engineering service.

The problem of educating the public in general and the municipal officials in particular, to the need for getting the best engineering counsel and allowing free but economical expenditure of funds for extensions, repairs and maintenance, is a big one. This problem of education is applicable to other administrative offices, but there are organizations which for years have been working on the general problem. For the engineer, there is no national agency through which pressure can be applied to achieve the desired results.

Part of the submergence of the city engineer into the mechanic trades stratum is his own fault. He is not naturally self-assertive. Often he is too easily satisfied. The position of city engineer carries with it certain responsibilities which are alluring. But the salary offered is almost invariably too small. These conditions, then, combine to set up strong barriers to prevent the more ambitious of his fellows from breaking down the public unconcern.

It is quite true that in numerous instances the city engineer is not competent. He may have grown up with the town suddenly to find himself facing technical problems which the younger community had never imposed. This engineer is simply a surveyor. And because he refuses to recognize his own limitations there are endless small communities served with slipshod, insanitary and inadequate structures.

There is another reason why the submergence of the engineer is difficult to overcome. Political expediency knows no bounds. "Economy" and "businesslike methods" are featured in campaign slogans the country over. The result is that all too frequently the smaller, though ultimately more costly, expenditures are made, and the more extensive and broader programs of public improvement are shelved. The average small town politician is too set in his belief that piecemeal construction is best, to accept the urgency of engineering work, the cost of which appears far beyond the city's ability to pay. It is here that the engineer of the small city has a golden opportunity, through the force of his own personality and through the strength of his technical society, to wield helpful and constructive influence, thereby improving his status and that of the profession.

Let it not be inferred that anything in the foregoing implies a belief in civil service as a panacea. This is not the case. Civil service regulation of city engineering employees may or may not be advantageous, depending upon local conditions. By far the better plan is to make the position of the city engineer of a small community so attractive from all angles that competent engineering can always be procured.

Need for Education of Public

The fact, then, is outstanding that the greatest service which engineering societies and engineers themselves can do to improve the status of the profession in the smaller communities is to convince both the public and its representatives in the political municipal organizations that the city engineer must be given greater responsibility, both in planning new work and in maintaining existing structures; that ample provision must

be made for carrying an adequate office force; and that sufficient funds must be provided for initiating and executing whole programs of public improvements.

It has been our observation in this series of studies that city engineers are invested with greater responsibility and their offices with more dignity in cities where either the commission-manager or the council-manager form is in operation than where other forms of government exist. Examining the conditions further, one finds that in a large majority of cases the city manager himself is an engineer, or, if not an engineer, a professional man who thoroughly recognizes the value of securing competent technical supervision of city services. Such a condition leads to a thorough appreciation of what the city engineer's problems are; and if the manager is an engineer, he makes the proper administration of engineering one of his chief concerns, though he leaves the city engineer free in his own field. The political structure matters little if the city's lay officials thoroughly appreciate engineering competence.

In the cities studied, the political structures are divided fairly evenly between the old mayor and council and the commission form. City managers are found frequently where one or the other form exists. But the ideal manager plan goes with the commission.

In restating the general conditions which should obtain in the management of the ideally-organized municipality, these five considerations stand out:

The city engineer should be free from political interference.

Adequate provision should be made for flexibility in office and field forces.

Adequate funds should be provided for engineering expense.

The city engineer should be given full control of engineering services.

Provision should be made for getting the best consulting advice on large projects.

If city engineers were appointed for a four-year term or longer, greater efficiency in the control of engineering service would doubtless result, provided the appointees were competent technicians. Questions as to making more sure of competency than is usually the case and the desirability of permanency for competent men during good behavior suggest the adoption of civil service, which is too large a question for more than mention here.

Details of Ideal Organization

In numerous instances, it has been noted that the city engineering department has been entirely inadequate for carrying on the barest details of the office. Such cities are woefully lacking in maps and similar data and the field work does not get the attention that it deserves. Naturally, the size of the city engineer's organization depends upon many factors, which include the age of the engineering structures, the funds available for betterments, difficulties met in construction due to topography, climate, etc., and the occurrence of special problems. It is believed, however, that for an average city of 50,000 inhabitants, the city engineer should have at least two assistants—one for the field and one for the office—two field parties and one draftsman. Actual observation of city engineering operation has shown a minimum force of one man—the city engineer himself—for a city of 25,000, and a maximum of 25 men for a population of 75,000.

Budgetary provision for personnel and engineering expense has been found in numerous cases to be entirely too low for the proper administration of engineering functions. It is believed that this budgetary provision ranges between $10,000 and $12,000 yearly for the average city visited. This figure is too low. It is obvious that with but $10,000 a year a city engineer can not pay his own salary and those of two competent assistants and keep his office going. The salary of the city engineer himself has been found to average about $3,000, which again is considered too low for a city with a population of 35,000 or upwards. It is believed that with the organization indicated above, the budgetary provisions for engineering and office expense should be at least $18,000 annually.

Besides a fixed provision in the budget for salaries and engineering expense, there should be flexibility in the hiring of new men during the year to meet any peak in construction work. If new work is to be paid for by bond issue, a certain percentage should be included for engineering expense. If appropriations are made out of the general fund for unusual expenditures, an additional allotment should be included for expense. Thus the city engineer would be given freedom to expand his forces to meet any urgencies in construction.

Free Hand Needed

In the control of his own services, the city engineer should exercise practically a free hand. He should be allowed to decide questions of technical moment without advising with his lay superiors. Frequently, work is held up and methods of operation complicated by insistence on the part of political superiors of the city engineer that they have a voice in deciding questions concerning which they have no real information. This insistence, if carried to its logical conclusion, could result in inferior work. To cite an example:

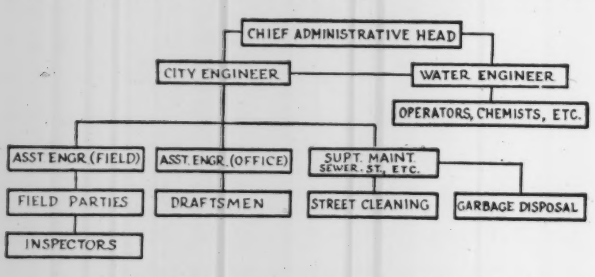
In a certain Southern city, the city engineer, whose immediate superior was the superintendent of public works, was engaged upon new street work. Without advising as to details on the pavement construction with his superiors the city engineer had put in the grade stakes for excavation. The superintendent of public works went to the job, and not being able to visualize how the finished grade and the crowned base would look, objected to the engineer's procedure. Whereupon the city engineer requested the superintendent of public works to put in the grade stakes as he saw fit. This was done, and the engineer built the pavement under his direction. However, the city engineer secured the written promise from his superior that he, the superintendent of public works, would be responsible for the manner in which the pavement had been constructed. When the surface was down, the section was so irregular that drainage was practically impossible and the street surface uneven. The street had to be entirely rebuilt.

Inasmuch as the city engineer in the average community of about 50,000 is not especially trained in all branches of engineering, it is obvious that for very large programs consulting advice is necessary. The engineer himself will almost always insist upon securing consulting advice and the general municipal organization should provide for engaging the best there is. In case of the creation of an engineering board for the design and construction of some unusual feature it is believed best that the city engineer be a member.

In the assignment of duties to the city engineer and

the division of them under him, it is believed that the best practice is to have all design, construction and maintenance under either direct or indirect control. There is a certain tieup of functions, whether of design, construction or maintenance, which makes this obviously the best practice. Also, the city engineer should be co-ordinate with other administrative officers.

One of the advantages of having all maintenance under the city engineer is that frequently maintenance equipment can be used for odd reconstruction jobs of such small size that bids are deemed unnecessary. This allows a certain flexibility in the use of all city-owned equipment and personnel. Finally, however, the controlling reason for all maintenance being under the city engineer is that so often maintenance contains actual problems of design or construction or both.



City Engineer's Organization in Ideal City

This chart is not meant to have an exact or complete application. It indicates the general organization of city engineering personnel only and is susceptible of minor changes, providing the main divisions of work remain the same as indicated.

Water-works require special consideration; likewise other utilities when under municipal ownership, as they are far less frequently. Broadly, water-works design, construction and operation is engineering work, and since the ideal plan would bring all engineering work under the city engineer he should control water-works. However, municipal water supply is a long-established, complex and highly specialized service which in many cities has been separately administered for decades. Moreover, under the plain commission plan, and some other types of city government as well, all the utilities are put under a department of that name and all other engineering services under a works department. For these reasons our present proposal is to go no further than to indicate that water-works engineering should come under the city engineer in liaison with a water-works superintendent, who should be in charge of operation, with a chemist or bacteriologist under him in direct charge of water treatment. The commendably increasing tendency to put engineers in charge of water-works suggests that water engineer might be substituted for water-works superintendent.

To make the duties of the city engineer plainer, a chart is herewith reproduced. As stated, the city engineer should be the supervisor of all engineering functions. His control over design and construction of paving, sewers, sidewalks, curbs and gutters—which incidentally comprise his chief duties—is through two assistant engineers who are directly responsible for the work. He should have such supervision over maintenance that any questions involving technical knowledge should be referred to him by the superintendent of maintenance. Most of the maintenance work, however, can be carried on easily without any but the most casual sort of supervision from the city engineer. In some cities, where street patching, curb replacement, sewer cleaning, etc., do not take up too much of the time of the maintenance superintendent, that individual could also supervise street cleaning and garbage disposal. In larger communities, it may be necessary to employ separate men for these jobs.

It may clarify this part of our discussion to state that the city engineer may be considered as head of the department of engineering, with the separate services in his control, where their number, importance and the size of the city warrant, under bureau chiefs. Where the local municipal scheme of organization includes a department of public works, it may be expedient to have the title city engineer give way to chief engineer, department of public works. Or better, to consider, as is the case in many city-manager cities, all engineering work concentrated under a director of public works or utilities, who may or may not be the city engineer but who should be a technical man.

Right here it should be said, further to emphasize the fact that we are dealing with the man who does the engineering work, rather than the title "city engineer," that in numerous instances the city engineer is little more than a surveyor. Technical details are divided among a number of bureau chiefs so that the city engineer has little more technical authority than several lay superintendents. If this division is to be made, undoubtedly the director of public works should be an engineer, for if he is not there is bound to be incomplete, if not incompetent, administration of certain engineering functions. In this survey Portland, Maine and Lynchburg, Va., present two capital examples of administration wherein all engineering under a director of public works is controlled by technical men of ability.

Immediate Remedies

Since it is apparent that conditions in many small cities are deplorable, perhaps the best opportunity for early consideration lies in a drive for higher salaries. The movement to gain better pay for engineers in the employ of large cities has started. Group demand for better pay is more simple in large communities, but it offers leverage for the unorganized employees. The following editorial in *Engineering News-Record* of Dec. 31, 1925, p. 1056, is particularly apt here:

> Engineering employees of our larger cities are proceeding in a dignified and orderly way in their campaign for a better salary schedule for government engineering work. The movement in the two largest cities has grown to include representatives of many of the employees of the next lowest in population and the extension still further down the scale may be expected. It might be thought that the campaign could be conducted by one of the existing engineering societies, but it is probably just as well to let the movement go ahead as it is started, for those who are back of it are actuated by a single purpose and can therefore concentrate their efforts. Part of these efforts, however, should be directed toward the national societies, for they have a certain influence that the city engineering employees cannot afford to neglect. Just at present the important thing is to arouse the engineering staffs of all of the cities to the necessity for courageous co-operative effort in each city. Later can come the group drive for recognition. Meanwhile all of those back of the movement may heed the warning of one of the high salaried engineers at the New York meeting two weeks ago, that it is much more important that the $1,500 to $3,000 engineer get a 25 per cent increase than that the $12,000 engineering executive be raised to $20,000.

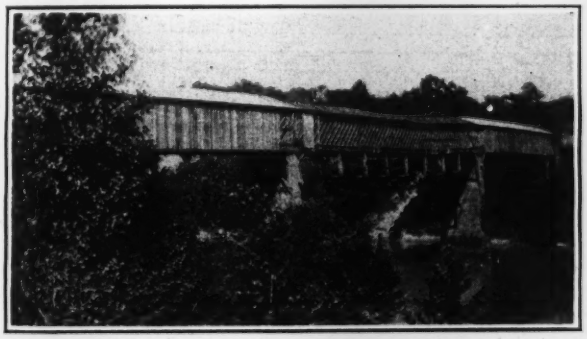
With better salaries will come greater competence and the gradual raising of the small city engineer to the status which his responsibilities should assure him.

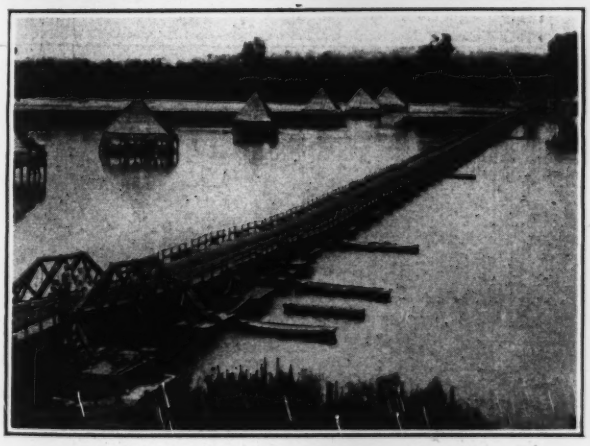
Highway Bridge Construction Activity in 1925

Bridge Replacement and Construction Going On at Exceptional Rate in all Sections—Many New Crossings of Large Streams Being Built and Projected — Activity Promises to Continue

HIGHWAY bridge construction in 1925 was unusually active throughout the country. Expenditures were larger than in any prior year, and even after making allowance for changed purchasing power of money the year's work is found to be the largest for at least ten years back. Evidently, highway bridge work has been resumed on full scale after the setback of the war and the subsequent period of difficult financing. The current activity is significant not only in its technical aspects but also as an index of present demands and future activity.

Nearly every state shows an increase in expenditure over the preceding year. Examples are $950,000 (against $750,000) for Virginia, $2,000,000 (against $1,600,000) for Indiana, and $1,600,000 (against $1,200,000) for Georgia. For the country at large the increase over 1924 may be estimated at 10 per cent. From the construction statistics collected by *Engineering News-Record* for many years past, the total of bridge contracts let in 1925 is $70,000,000, which reduced to a 1913 cost basis is about $34,000,000; the latter figure is 50 per cent above the 13-year average and is exceeded only by the 1914 figure. As these statistics include only contracts above $25,000, however, the total expenditure on highway bridges is much higher, and the year's total probably reached $100,000,000, of which $50,000,000 represents state and federal aid work and $40,000,000 city and county work.





Two Reasons for Highway Bridge Activity

Above: Lattice truss bridge over Chattahoochee River at Eufaula-Georgetown, just replaced by a modern structure. Below: Pontoon bridge in Arkansas, in use for more than thirty years (Arkansas River crossing at Dardanella).

In a Leading Highway State

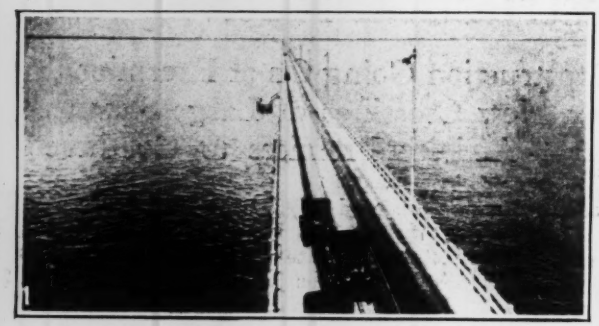
Backward features occur even on the best-maintained highways. The sign on the portal tells the story; its message is probably bad law and bad engineering.

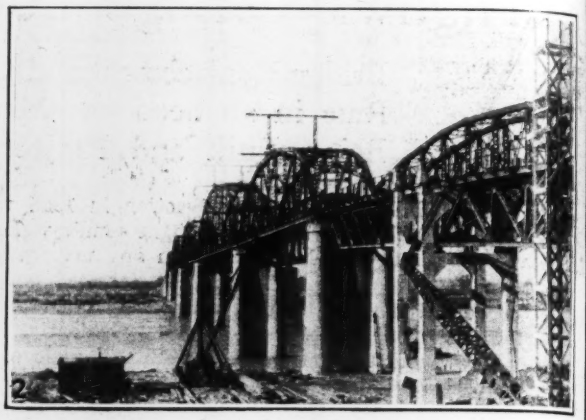
State bridge construction (including federal aid work) was most important in relation to general highway service, but city and county bridge construction involved larger single operations. In the latter field the past year or two have shown particularly great activity, after half a dozen years of stagnation of work by local authorities. In many cities the work so far done is only the beginning of an extensive bridge program.

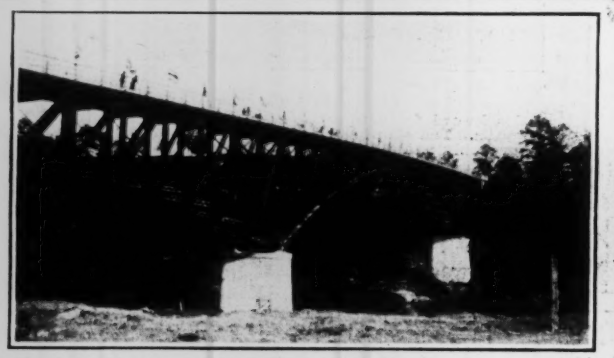
Probably because of improved financial conditions, major projects received much attention within the past few years. Crossings over large streams which hitherto have been barriers to traffic constitute a noteworthy part of the 1925 construction, and many major bridge projects are under study at the present time.

Toll-bridge construction came to occupy a more definitely recognized position during the year. The success of the Bear Mountain bridge over the Hudson, a private toll bridge opened a year ago, attracted wide attention. A number of toll bridges are under construction, and more projects of the same kind are being promoted, in most instances with whole-hearted public support, as the public has need for the improved facilities and is willing to pay for them through service charges rather

Some Items of Highway Bridge Construction in 1925







1—Gandy Bridge, Tampa Bay, Florida

2—Lexington Bridge over Missouri River

3—Des Plaines River Crossing, Summit, Ill., on a Main Entrance to Chicago

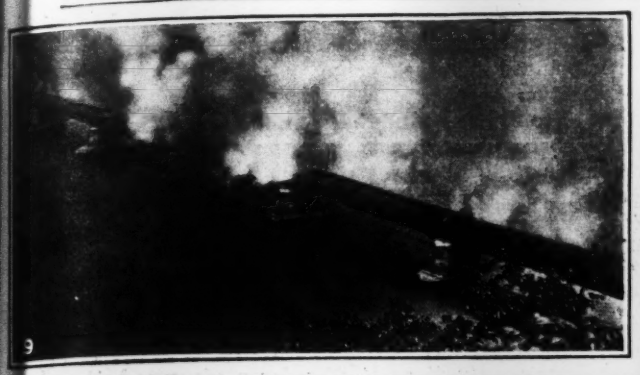
4—Cache River Bridge, Cairo-Vandalia Road, Illinois

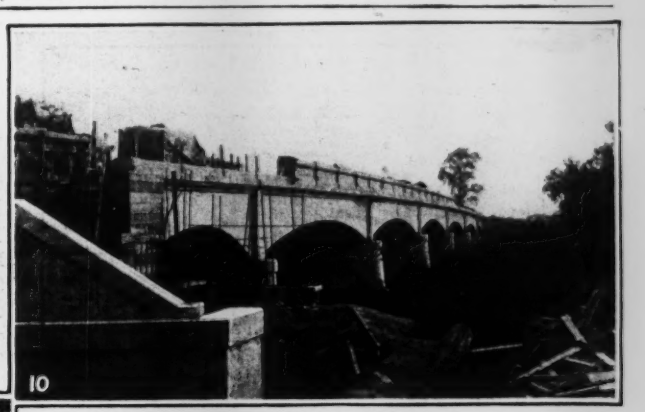
5—A Georgia Cantilever Arch Bridge

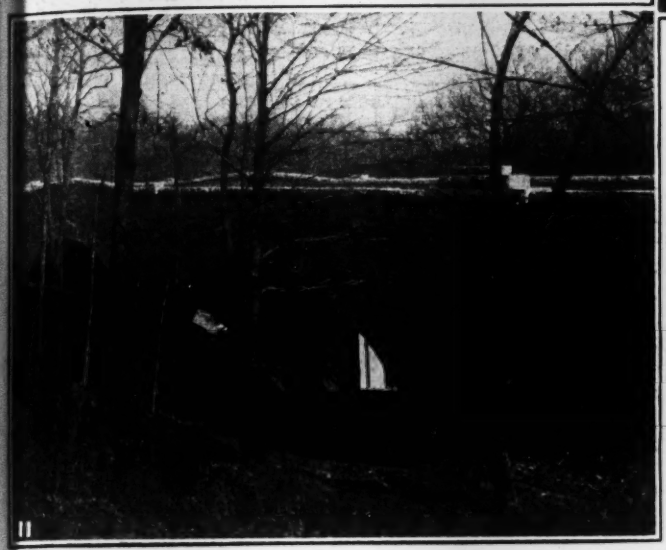
6—Erection of Swing Span of Alabama River Bridge, 7 miles from Montgomery, Ala.

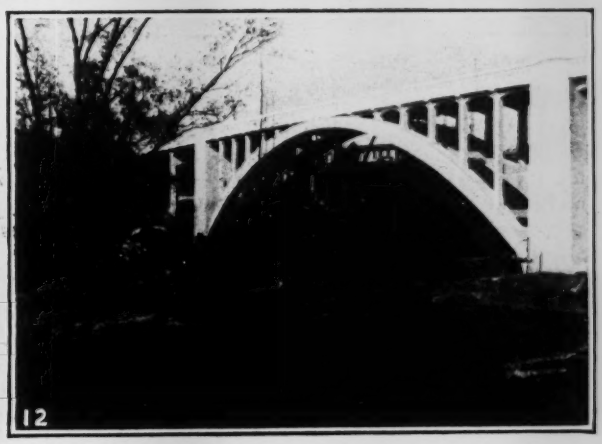
7—Philadelphia-Camden Bridge, Delaware River

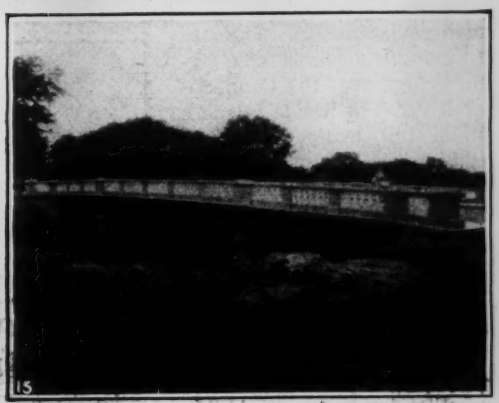
8—Erection of Seventh St. Bridge over Allegheny River at Pittsburgh











9—Old Susquehanna River Bridge, Northumberland, Pa., Burned Two Years Ago (see view 13)

10—First Cantilever-type Concrete Bridge in Michigan (Raisin River Bridge at Monroe; 42-ft. Roadway)

11—Sheridan Road Bridge at Glencoe, Ill.

12—Three-Hinged Concrete Arch Span at Jackson, Miss.

13—New Northumberland Bridge over Susquehanna River

14—A Maryland Grade-Crossing Elimination (over Baltimore & Ohio R.R. at Stepney)

15—One of Twelve Identical Bridges at Wichita, Kan.

Five-Mile River Marsh Crossing
A typical class of work in the Southern coastal plain.

than tie up public funds and increase taxes. A few public toll bridges are included, one or two under construction (the Poughkeepsie bridge across the Hudson, the Philadelphia bridge across the Delaware) and others in contemplation (the Mount Hope bridge in Rhode Island, Arthur Kill and Fort Lee bridges at New York City).

In the following a brief high-light summary of state highway bridge construction is given by regions and states, based on incomplete returns from the several highway departments.

Atlantic Coast States

The largest expenditures and most significant operations along the Atlantic Coast related to bridges over estuaries or the lower courses of streams of the coastal plain. South Carolina and Georgia have in particular given very thorough attention to the latter problem, as until within the last two or three years the half-dozen major streams through these two states were unbridged for distances of a hundred miles or more from the coast.

In Maine, small bridge work was the rule, but a large drawbridge over the Taunton River between Hancock and Sullivan will be opened in the spring, replacing a ferry. A similar ferry replacement in prospect at Bath, over the Kennebec, will involve $3,000,000. New Hampshire and Massachusetts also were largely occupied with small replacements. The city of Springfield completed a second bridge over the Connecticut River. In Rhode Island a public toll bridge is under study by the Mount Hope Toll Bridge Commission, to connect the island of Rhode Island with the mainland at Bristol Neck, crossing over the entrance to Mount Hope Bay (3,100 ft., high level). If built, it will be the first toll bridge on the state highway system.

New York State is occupied with construction of the Mid-Hudson bridge at Poughkeepsie, to be operated by the state as a toll bridge (1,500 ft. suspension span). Other state bridge work has been of minor character, but work planned for the coming year includes the reconstruction of some 200 bridges of spans varying from 10 to 225 ft. Study of a bridge across the lower end of Lake Champlain is going on and there is agitation for a third bridge across the tidal section of the Hudson. Of other important bridge operations in New York, the beginning of construction on the Buffalo-Fort Erie bridge (toll, private) over the Niagara River is to be noted, completion of the Western Gateway bridge over the Mohawk at Schenectady, and approval of plans of the Port of New York Authority for two public toll bridges over Arthur Kill between Staten Island and New Jersey, as well as studies for a gigantic bridge across the Hudson River between Fort Washington and Fort Lee, at New York City. New Jersey's principal contributions to highway bridge improvements were continuation of work on the new Raritan River crossing at Perth Amboy and on the still greater Philadelphia-Camden interstate bridge, both near completion.

Pennsylvania, with a $3,000,000 program during 1925 (not counting expenditure on the Philadelphia bridge), built a $400,000 concrete-arch crossing of 11 spans 110 to 120 ft. long over the wide reach of the Susquehanna at Northumberland, replacing an old wooden bridge burned two years ago; all the larger operations were replacements. Very extensive bridge work was carried out and is still in progress in the Pittsburgh district, including the rebuilding of three bridges over the Allegheny River (at 6th, 7th and 9th Sts., the 7th St. bridge now nearing completion), an important and difficult bridge over Turtle Creek (com-

Typical Examples of Costly Valley Bridges
An Indiana federal-aid bridge. An Ohio county enterprise (Hilliard Road bridge over Rocky River, near Cleveland, Cuyahoga County).

pleted), beginning of work on three Monongahela River bridges, one of which is to replace the old and interesting Point bridge and the other is to provide access to the Liberty tunnel. Two bridges over the Susquehanna were completed at Milton (county) and at Clarks Ferry (private, toll), and two others were begun, at Harrisburg (private, toll) and at Columbia (county), all replacements.

Delaware and Maryland work was largely minor bridge replacement, some of it necessary to give two-line width to old one-line bridges (seven of these located on the National Pike). Virginia's work on major structures was in large part concentrated along the coastal fringe, bridging estuaries and streams which have heretofore compelled long detours. A mile-long bridge over the Rappahannock River at Tappahannock, of steel, concrete and creosoted timber, is the principal new crossing, replacing a ferry. Existing old structures of steel or wood, no longer serviceable, are replaced by a 500-ft. concrete bridge at Occoquan, a steel draw over Nomini Creek at Mt. Holly, two bridges on Washington-Richmond highway, a steel and concrete structure with draw over the west branch of the Elizabeth River at Hodges Ferry, a 200-ft. bridge with bascule at Smithfield. Completion of the Washington-Richmond highway improvement during the coming year (concrete) will require a considerable number of special bridges. Improvement of stream-crossing conditions along the shore also includes construction of a toll bridge about 2,000 ft. long (creosoted trestle with steel draw) over the Pamunkey River at West Point.

West Virginia, which completed 41 bridges at a cost of $750,000, built as its most important structure a bridge over the Gauley at Gauley Bridge, on a main east-west route, 670 ft. of steel spans, replacing a toll ferry operated since the Confederates in 1863 destroyed the old bridge (first built in 1822). An interstate bridge is being built across the North Branch of the Potomac at Piedmont, at Westernport, Md. Two private toll bridges over the Ohio are under construction, at Huntington, giving an important connection with highways to Columbus and Cincinnati, and at Benwood, to Bellaire, Ohio.

Southern States

The southerly coast region was largely occupied with major stream crossings. In North Carolina, a bridge over the Cape Fear River at Wilmington is being planned. South Carolina built a bridge across the Ashley River at Charleston, an essential link in the Atlantic coastal highway (20 concrete cantilever spans and bascule, 34-ft. roadway; cost 1¼ million). The Savannah River bridge, 5 miles in total length (*Engineering News-Record*, Oct. 8, 1925, p. 590), was an interstate undertaking, the design handled by Georgia. These two structures, together with the Santee River bridge north of Charleston, completed two years ago, removed three extensive barriers heretofore existing to highway travel through the coast region to Georgia and Florida points. An important bridge of similar character, crossing the Savannah 4 miles below Augusta, was completed early in the year (steel and reinforced-concrete, 1,500 ft.). Other major bridge work includes a long steel draw structure over the Black River near Georgetown, and two steel and concrete bridges over the Saluda River. A $500,000 bridge will be built over the Congaree at Columbia.

Georgia's most important undertakings were two bridges over the Chattahoochee (at Eufaula and Fort Gaines); the Savannah River bridge near Savannah, above mentioned, and three other bridges over the Ogeechee, Chattahoochee, and Satilla. Over $2,000,000 cost is represented by the bridges completed during the year (23,100 lin.ft.); 1926 work will be somewhat less (17,300 ft.).

Concrete Decks on Steel Are Widely Used

Florida conditions demand numerous long causeway-type structures, usually with draw. Crossings of this kind over the Choctawhatchee, the Sebastian and the Kissimmee were completed, the first-named replacing a ferry. Creosoted timber trestle forms a large part of two of these, while the Sebastian River bridge, twenty-one 40-ft. spans of concrete deck girders, was given special treatment for seawater protection. Four major crossings are under construction, including an interstate job on the Atlantic Coastal Highway and the 3½-mile Escambia Bay crossing at Pensacola; six others are proposed for the current year. Several large structures are now in progress by local authorities and private parties.

Alabama work was eliminating ferries, five bridges of this kind being completed. The state co-operated with Georgia in building the Eufaula and Fort Gaines bridges, doing the engineering on the former (670-ft. steel structure of three spans, replacing a covered wooden lattice continuous-truss bridge built in 1854). Ferries were replaced by bridges over the Tallapoosa at Alexander City, over the Tombigbee near Coatopa (160-ft. vertical lift), over the Alabama near Montgomery (336-ft. swing span), over the Coosa near Leesburg (250-ft. swing span), and over the Tennessee at Albany-Decatur (12 concrete two-rib arches 103 to 124 ft. and 204-ft. two-leaf bascule). A reinforced-concrete arch bridge of 12 spans is under construction on the Florida short route, at Gadsden.

Mississippi completed two important bridges on the main north-south highway through the state, over the Yazoo at Greenwood and over the Pearl River at Jackson, the former having a 292-ft. center-bearing swing span, hand operated, while the latter is a high-level crossing containing a 180-ft. concrete arch span. Projected bridges over the Yazoo north of Vicksburg (two 350-ft. K-truss spans) and over Bay of St. Louis at Bay St. Louis, will replace ferries; the latter will be about 2 miles long and exposed to Gulf hurricanes.

[*This review will be concluded in our issue of January 21.*]

Status of the Major Engineering Projects

Bringing Up to Date the Stage of Design and Construction of the More Important Public and Private Works in United States and Canada

Cascade Tunnel

Rock tunnel 7¾ miles long to lower the summit elevation of the Great Northern Ry. in the Cascade Range of the Rocky Mountains, and thus eliminate serious expenses and traffic delays due to snow troubles at the present higher elevation. Electric operation. Contract let in December, 1925, and preliminary work begun at once for construction camps. Will be driven by pioneer tunnel and center heading from west portal, by center heading only from east portal, and by center heading only from Millcreek shaft, which is approximately three miles west of east portal and is approximately 800 ft. deep.

Moffat Tunnel

Six-mile railroad tunnel under James Peak, Colo., between east and west sides of Continental Divide being built by the auxiliary pioneer tunnel method. Pioneer tunnel 78.3 per cent completed, main headings, 78 per cent, cross-cuts from pioneer to main heading tunnel 77 per cent complete and full railroad section 51 per cent complete. East Portal in solid granite and gneiss but first two miles in from west portal in heavy ground of badly shattered gneiss and schist requiring heavy timbering adding from $100 to $200 per foot to the cost. At present rate of progress main headings will be holed through in July of this year. Probably will be ready for traffic early in 1927, several months ahead of contract date July 20, 1927.

Pueblo Flood-Protection

Begun in March, 1924, by newly formed Pueblo Conservancy District. The 1921 flood, which led to the formation of this district, had peak flow of about 100,000 sec.-ft. through the city, overtopping the levees and doing extensive damage. Works consist of relocated river channel along edge of south mesa inclosed by a north levee giving 2½ mile channel, 30 ft. deep, and retaining dam 6 miles upstream, at Rock Canyon, to throttle sudden flood flows. Channel capacity 125,000 sec.-ft. at 3 ft. freeboard and about 150,000 sec.-ft. at bankfull stage. Now practically complete about a year ahead of schedule.

Hetch Hetchy Project

Work on the mountain division of San Francisco water and power project, including storage dams and 18-mile tunnel, is finished. Expenditures to date exclusive of interest total $44,000,000. Moccasin Creek powerhouse was recently completed and power is now being sold to Pacific Gas & Electric Co. Work of placing submarine pipe across San Francisco Bay is nearing completion and 21-mile Bay division is to be completed and carrying Spring Valley water within a few weeks. Before Hetch Hetchy water can be delivered about 45 miles of tunnel and 49 miles of pipe line remains to be built.

Hydro-electric Construction in California

Power companies all extending their generating systems on a construction program planned to keep abreast of steadily increasing consumption. Three important projects now under way and scheduled for completion in about one year are: Balch plant of San Joaquin Light & Power Corp., effective head 2,243 ft., to contain two 20,000-hp. impulse wheels; Melones plant being built in conjunction with Oakdale and South San Joaquin irrigation districts, effective head 228 ft., to contain two 17,000-hp. turbines; Bucks Creek plant of Feather River Power Co., impulse wheels. Pacific Gas & Electric Co. recently completed Pit River 3 plant containing three 33,000-hp. reaction turbines operating under effective head of 280 ft. and is now beginning Pit River 4 involving dam, 4½-mile tunnel, and ten miles of railroad. Southern California Edison Co. finished the 13-mile Florence Lake tunnel last year and is now driving the 5-mile Huntington-Shaver tunnel.

St. Louis Water Supply

On the $12,000,000 project for water from Missouri River items totaling $5,500,000 are under contract; of this $500,000 is for land and 16-mile 60-in. pipe-line right-of-way connecting station with city. Eventual plant will cost $25,000,000. Specifications for pumps, boilers, settling basins, buildings and filters are well along and contracts will be let in rapid succession, the first within 60 days. Intake and engine pits 80 per cent complete, pipe line, 75 per cent. Probably plant ready to furnish water to city early in 1928.

Kansas City, Mo. Water-works

Contracts let totaling 7½ million dollars. City political situation favorable to construction progress. Intake and low lift pumping station on the bank of the Missouri River one-third complete; preliminary and final settling basins about 23 per cent complete; filtration and secondary pumping plant is slightly over one-third finished. These structures are all on the Kansas side of the river. Missouri River tunnel that carries the filtered water under the river to the distributing pumping stations in Kansas City, Mo., about 10 per cent complete; Turkey Creek tunnel to existing Turkey Creek pumping station and steel pipe line to new East Bottoms pumping station both slightly less than one-third finished. Over half of East Bottoms station has been constructed. Whole project probably ready for operation early in 1928.

Illinois Waterway

Link in Great Lakes and Mississippi River waterway for barges; being built by state of Illinois. Length, 63 miles from the Chicago drainage canal at Lockport to the Illinois River at Starved Rock, to provide for future 14-ft. waterway. Marseilles lock, completed; Lockport lock, 65 per cent completed; Starved Rock lock, contract let in January, 1926. Two locks and Marseilles diversion canal not yet under contract. Completion of waterway expected by 1930.

Chicago Drainage Canal

Sanitary District of Chicago carrying out $120,000,000 treatment program in provision under which War Department granted 5-year permit for an 8,500-sec.-ft. diversion of Lake Michigan water down to Illinois Valley. $30,000,000 already spent and $20,000,000 of $42,253,953 budget for 1926 will probably go into new work. North Side activated-sludge treatment plant for 800,000 people, largest yet built, 44 per cent complete. Probably complete plant in 1928. West Side $13,300,000 plant for 1,850,000 people to be started soon. Congress will probably soon attempt to settle the question of permanent diversion.

Delaware River Bridge

Cable work completed and suspended structure erected complete during the year. Reinforced-concrete floor slab placed and approaches built except for finishing work. Progress maintained at a rate promising completion of the entire structure ready for public traffic well before the originally intended opening date of July 4, 1926, but delay now threatens as a result of a difference of attitude of Pennsylvania and New Jersey concerning collection of tolls on the structure. The original New Jersey authorization and bond issues were based on interest payment and amortization from tolls, but the last appropriation by the Pennsylvania Legislature contained a proviso that the money

should be spent only for a structure which would return no tolls to Pennsylvania or Philadelphia. Because of this conflict, the commissions representing the two states ceased co-operating about the middle of the year except to keep current work going. The matter is to be taken up as one of the items of an extra session of the Pennsylvania Legislature soon to meet. In the meantime, sentiment in Pennsylvania has been found to be widely favorable to tolls, agreeing with the New Jersey sentiment.

Muscle Shoals

The dam and power house at Muscle Shoals have been completed and the turbines and generators are being installed. The first four units of 30,000 hp. each were put into operation during the year. Other units are nearing completion. The ultimate capacity of the plant will be 610,000 hp.

Arlington Memorial Bridge

Congress this year authorized construction of the long-planned monumental bridge across the Potomac River at Arlington, near the Lee mansion, to improve traffic connections south and beautify the capital. Exploratory and design work was begun promptly in the office of public buildings and grounds, and progressed to the point of calling bids on foundation work just after the close of the year. Designed with lavish architectural adornment, the bridge will be one of the most costly of its size in the country; the ultimate expenditure probably will exceed $15,000,000.

Chesapeake and Delaware Canal

Original lock canal 17.9 miles long between Chesapeake Bay and Delaware Bay, built in 1829, is being enlarged and cut down to sea-level canal 90-ft. bottom width, 12 ft. deep. Excavation, 16,000,000 cu.yd., is completed except at old locks and bridges amounting to about 425,000 cu.yd. Bridge building and lock removal are now in progress. This year will witness virtual completion.

Philadelphia Subways

Five contracts covering 6¾ miles of 4-track subway from City Hall North to Olney Ave., Philadelphia, are being executed. Work has been carried on rapidly since first contracts were let in the summer of 1924. One section is ready for track-laying and the whole is expected to be complete by the end of Mayor Kendrick's term.

Passaic Valley Trunk Sewer

The trunk sewer from Paterson to Newark, N. J., with pumping and sedimentation plants on the Newark Meadows, a tunnel beneath Newark Bay, the Bayonne Peninsula and a portion of New York Bay, with multiple outlets in deep water near Robins Reef Lighthouse, was put in use in August. The works, which serve twenty cities and towns in the lower Passaic Valley, including Paterson and Newark, have been built under the direction of the Passaic Valley Sewerage Commission.

Holland Tunnel

Twin vehicular tunnels under the Hudson River between New York City and Jersey City. Both tubes holed through; construction work on New York approach practically complete. Construction work on Jersey City approach about 50 per cent complete; concrete lining finished in both tunnels and tile facing and granite block paving now being placed; contracts let for ventilating building and equipment. Probably will be open for traffic toward the end of 1926.

New York Subways

Sixteen contracts on the Eighth Ave. line from Eighth Ave. and 18th St. to 214th St. and Broadway were let during the past year; three contracts remain to be let. Total cost of line about $80,000,000. Contracts upon which work is being done range from mere beginnings to two that are about 50 per cent complete. Queensborough extension has been finished from Grand Central Station to Fifth Ave. and the line that far will probably be put in use during February, work waiting upon the installation of third rail by the Interborough Rapid Transit Co. From Fifth Ave. to Eighth Ave. work is progressing. On the Fourteenth St. work in Brooklyn two contracts are 75 per cent complete, and bids upon a third were received Jan. 11. The rest of the work is hanging fire, due to certain negotiations with the Long Island R.R. The Flushing extension is practically complete, the only remaining thing to be done to put the line in use is the building of the combined rapid transit and highway bridge across Flushing Creek.

Port Authority Bridges

New York and New Jersey Legislatures authorized their Port Authority a year ago to connect Staten Island and New Jersey by bridges across Arthur Kill at Elizabethport and Tottenville, these bridges to be financed by Port Authority bond issues repaid by bridge tolls. They also appropriated $400,000 for each bridge as part of a five-year program of appropriations, to cover about 25 per cent of the total cost to facilitate financing of the remainder. Preliminary plans for both bridges were approved by the War Department late in the year. Money appropriated by both legislatures for an investigation of the feasibility and cost of a bridge across the Hudson River at Fort Washington, in upper Manhattan, was used for making borings and for traffic and design studies. The crossing would require a suspension span of about 3,400 ft. This bridge also is likely to be a toll structure if built by the Port Authority.

Catskill Aqueduct System

The Gilboa dam was nearly completed during the year and will be in use by the middle of 1926, it is expected. It forms a 20-billion gallon reservoir and will direct the water of Schoharie Creek through the 600-m.g.d. Shandaken tunnel completed in 1924, to Esopus Creek and thus into the existing Ashokan reservoir, from which the 156-mile Catskill Aqueduct leads to New York City. The Gilboa dam will virtually complete the Catskill aqueduct system, as originally planned. Contracts were put under way during 1925 for a steel conduit in Brooklyn, some six miles long, mostly 72 in. in diameter, as a main distributor of Catskill aqueduct water brought to Brooklyn by the existing deep pressure tunnel. Plans for a second deep tunnel, about twenty miles long and for the most part 17 ft. in diameter, have been submitted to the Board of Estimate by the Board of Water Supply, but had not been acted upon at the close of 1925.

Great Lakes-St. Lawrence Development

International commission's engineering board engaged in study of combined navigation and power project. Survey parties nearing end of work and test borings for prospective dams well along. Report expected in the spring. Meanwhile army engineers engaged on report of alternate Lake-to-Hudson Ship Canal expected about same time. No legislative action in either country probable until after reports are made. Popular agitation for or against project marking time.

Welland Ship Canal

Work on the fourth canal between Lake Erie and Lake Ontario was started in 1913 but was held up by the war. The present canal with its 26 locks 270 x 45 ft. with 14-ft. draft is being replaced by one with 7 locks 859 x 80 ft. with 30-ft. draft and a lift of 46½ ft. and a lock 1380 x 80 ft. with a lift of from zero to 11 ft. depending on the level of Lake Erie at Port Colborne. The new harbor on Lake Ontario is practically completed. Work on five locks is nearing completion. Contracts for the entire work have been let. The stage of completion is: 43 per cent of the total 8,674,000 cu.yd. of rock excavation, 48 per cent of the 46,839,000 cu.yd. of earth, 70 per cent of 3,462,000 cu.yd. of watertight embankments and 52 per cent of 3,381,000 cu.yd. of concrete. It is hoped to have the canal completed for the opening of navigation in 1930.

Isle Maligne Power Plant

Eight of the 50,000- hp. units in the 600,000-hp. hydro-electric plant of the Quebec Development Co. at Isle Maligne, on the Saguenay River in Quebec, have been installed and are in operation. Provision for four more 50,000-hp. units has been made in the powerhouse. Work on the structures to control the flow from Lake St. John is nearing completion.

E. N-R. Annual Statistics of Cost and Volume

Construction Outlook

EVERYBODY expected 1925 would be a prosperous year—and it has been. The outlook for 1926 is as bright as was the outlook for 1925. This is particularly true for engineering construction other than buildings. This class beat the 1924 total by 11 per cent.

Building must be watched. An unprecedented boom is on. Building contract values reported by our correspondents were 40 per cent greater than for 1924. This was for projects of $150,000 up. Residential construction was 25 per cent heavier. The increase is in number as well as value. The building boom is nation-wide, as shown by the following per cent increases over 1924: New England, 42; Middle Atlantic, 61; South, 53; Middle West, 15; between Mississippi and Rocky Mountains, 45; Far West, 18. Further comparisons of gains by sections shown on opposite page.

The record year just closed shows the boom to be mainly in buildings. Construction other than buildings represents a process of steady, substantial growth in which the element of speculative excess is not present. The general cost level is below that of a year ago; proposed work is in greater volume. In most of the large cities building trades wage schedules will remain at last year's levels, throughout the first half of 1926

The accompanying figures show that the 1922-1925 period was one of gradual growth for engineering construction. There has been a steady gain but no boom. Taking a minimum of $15,000 on waterworks and excavating projects and $25,000 on other public works, the following represent the yearly totals of construction other than buildings, for the entire country: 1922, $607,647,000; 1923, $804,251,000; 1924, $858,891,000; 1925, $957,727,000. During this period there was an average yearly gain in construction costs of 6½ per cent. The only variable class of municipal construction at present is city bridge building which is away above normal and going up.

Personal communications from leading bankers over the country clearly indicate that the lending agencies are aware of the extraordinary activity in the building field. The impression seems to be that the much-talked of housing shortage has been met, and that there has been sufficient building, for the present, in certain types. On this subject bankers in various centers have the following to say:

Boston—"Overbuilt with respect to office buildings. The tide seems to have turned with respect to lease values, which would be a reason why financial institutions might be somewhat more careful in amounts advanced against buildings already erected or to be erected."

Philadelphia—"In this neighborhood there is a strong inclination to exercise great care in making loans upon new apartment houses and office buildings. I happen to know of three of the larger loaning institutions whose boards have passed resolutions against any further loans upon apartment houses, and we are all scrutinizing these loans and the office building loans with great care, only making loans in neighborhoods and under conditions which seem specially attractive.

"As to dwelling houses, in some neighborhoods we feel that building is being overdone, and in all locations we are discounting present selling prices very materially before determining what loans we shall make."

Baltimore—"Sufficient dwellings, high class apartments and office buildings. Not overbuilt and building operations continue along conservative and sane lines."

Cleveland—"Lending for construction purposes and probably shall continue doing so. Increasingly careful about type of construction. Shortage of less expensive dwellings and medium-priced apartments. If manufacturing continues at present pace there will be a demand for increased industrial facilities."

Minneapolis — "Enough apartments and office buildings. Enough for the present of buildings constructed by professional builders on speculation and without knowing that the buildings will be required."

Kansas City, Mo.—"Believes situation that caused the action of certain institutions in New York materially restricting their loans on real estate of greater New York is purely a local one. As far as Kansas City is concerned funds are as free for loans of this character at a proper rate as they ever have been known to be."

San Francisco—"Banks are lending as much as required for dwellings and office buildings, but have to a certain extent discontinued advancing money on apartment houses."

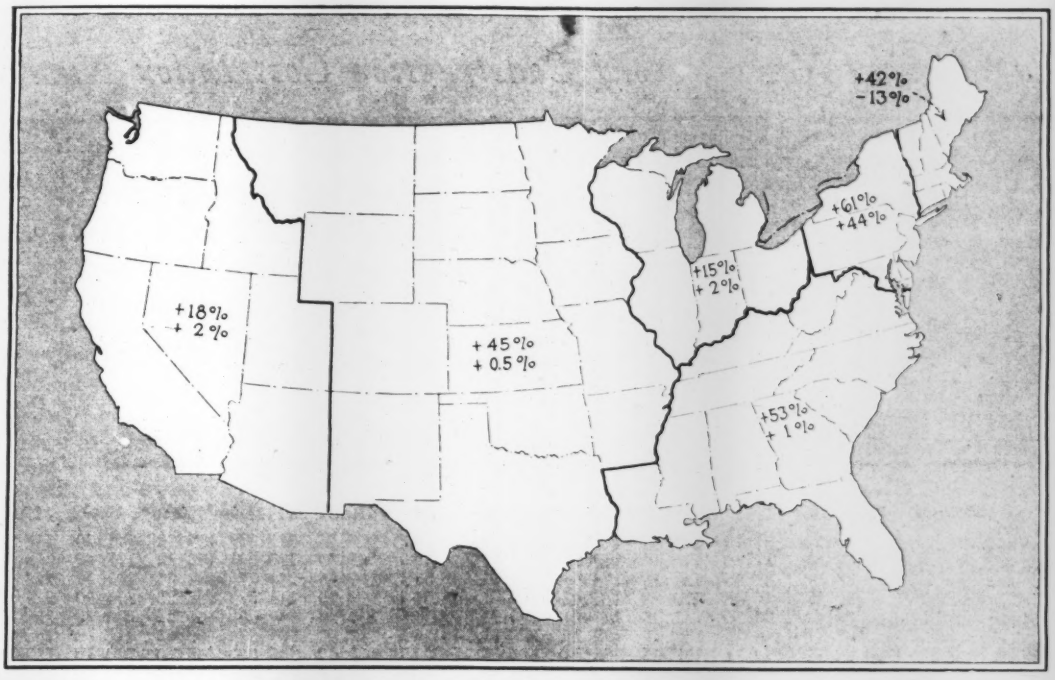
Seattle—"Percentage of occupancy of office buildings in neighborhood of 80 to 90 per cent. The increase in population of from 25,000 to 30,000 a year, may require shortly additional construction."

"BANKERS ARE NOT PIONEERS"

Reserved for the last is a letter most unusual, as coming from a banker. The writer does more than outline the situation in his home city; he shows that the banker's conservatism is no less ingrained in boom times than in panics. Following is an excerpt from the letter of Mr. Oscar Wells, president of the First National

Per Cent Gain In Money Value of 1925 Contracts Awarded Compared With 1924

In Each Section Upper Figure Represents Buildings—Lower Figure, Other Construction



Bank, of Birmingham, Ala.: "We are a commercial bank of course and we are not at all interested in mortgage financing, and the average banker is in constant fear of overexpansion in most lines of development and therefore is usually urging caution upon his patrons upon such subjects as overbuilding. It would seem that we have enough apartment houses and perhaps enough dwellings and certainly enough office buildings now. This is the attitude of bankers generally over the country, but you must remember that bankers are not good pioneers. They would wait until there was a demand for building an office building. Most of our cities have grown because men have built in advance of the demand. Even the losses of overexpansion have been the means of the profit to others when the community has caught up."

With respect to wages and prices, the stability that has prevailed throughout 1925 promises to continue for another year. Our correspondents in twenty-one cities report no serious labor disturbances. In sixteen of these centers the present wage schedules will prevail throughout the new year.

The curve of construction costs has remained almost flat at 24 per cent below the June, 1920, peak. Few changes are expected before spring. At that time, should the Florida demand remain heavy, ordinary advances may be looked for.

Therefore, it may be said that practically all factors favor a healthy, prosperous construction year. Costs are stable, labor is working, materials are available and transportation is better than ever before. It is quite possible that speculative building will be curtailed, which will be a good thing for the industry.

Engineering Construction Contracts—E. N.-R. Statistics

By Classes of Work

	1925		1924	
	No.	Value	No.	Value
Water-works	564	$69,368,000	582	$61,445,000
Sewers	584	84,577,000	562	74,553,000
Bridges	427	69,876,000	429	68,564,000
Excavation, etc.	168	40,080,000	139	27,010,000
Streets and Roads	2,589	421,039,000	2,774	415,216,000
Industrial Buildings	1,271	227,616,000	1,275	204,969,000
Commercial Buildings	2,835	1,374,100,000	2,383	935,430,000
Federal Government	327	34,272,000	352	38,885,000
Unclassified	478	238,515,000	449	173,218,000
Total	9,243	$2,559,443,000	8,945	$1,999,290,000
Average	....	$277,000	....	$224,000

By Geographic Sections

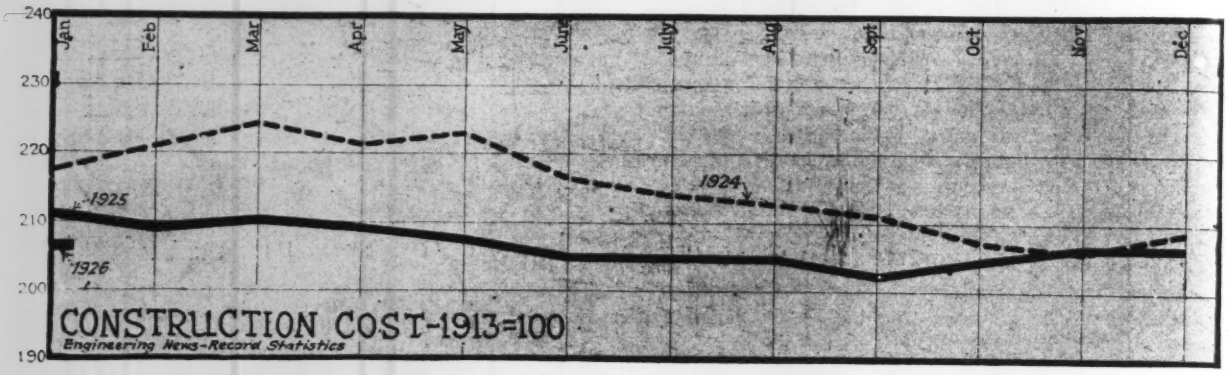
	1925		1924	
	No.	Value	No.	Value
New England	1,153	$199,370,000	804	$151,556,000
Middle Atlantic	1,671	935,216,000	1,713	601,152,000
Southern	886	247,966,000	989	208,072,000
Mid West	2,012	474,212,000	2,072	431,039,000
West of Mississippi	2,200	407,558,000	2,074	340,622,000
Far West	1,321	295,121,000	1,293	266,849,000
Total	9,243	$2,559,443,000	8,945	$1,999,290,000

Per Cent Changes Since 1924—Buildings and Other Construction

New England Buildings	+42
Construction other than buildings	—13
Middle Atlantic Buildings	+61
Construction other than buildings	+44
Southern Buildings	+53
Construction other than buildings	+ 1
Mid West Buildings	+15
Construction other than buildings	+ 2
West of Mississippi Buildings	+45
Construction other than buildings	+ 0.5
Far West Buildings	+18
Construction other than buildings	+ 2

E. N-R. Index Numbers

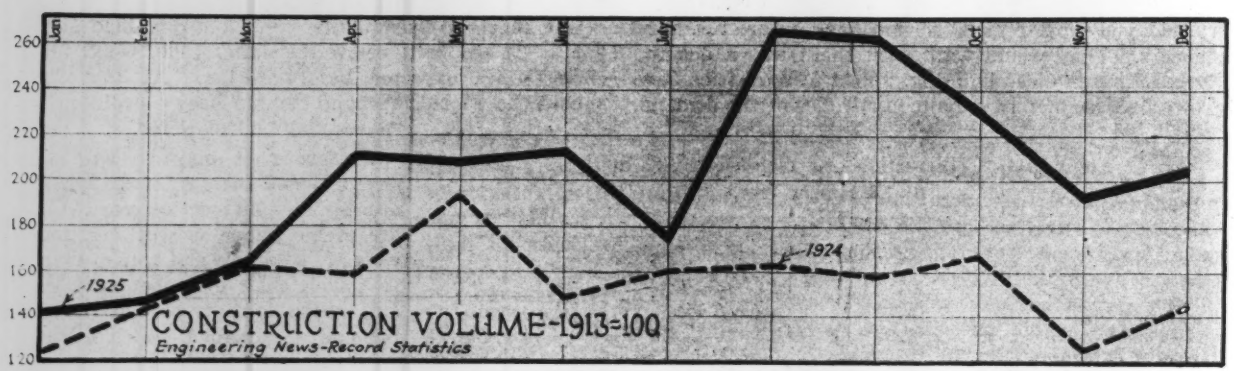
Engineering News-Record Construction Cost Index Number



	1914	1915	1916*	1917	1918	1919	1920	1921	1922	1923	1924	1925
January	89.22	87.12	112.66	167.75	184.51	198.05	206.55	230.87	168.72	191.70	217.90	210.40
February	89.22	87.36	116.66	167.75	184.51	201.50	225.10	230.67	168.72	197.40	220.30	209.70
March	88.97	87.66	125.16	175.66	184.51	198.05	240.85	224.27	162.04	205.25	224.70	210.20
April	87.97	90.16	129.51	183.41	186.01	191.25	265.20	213.07	164.72	213.50	221.60	209.55
May	88.62	90.16	131.06	187.61	186.01	191.25	268.90	210.82	164.62	216.70	222.38	207.20
June	87.87	88.96	128.71	199.26	186.31	191.85	273.80	209.82	166.62	220.70	216.85	204.60
July	88.12	90.51	127.96	204.01	188.65	193.65	265.65	203.82	169.70	222.10	214.40	204.60
August	90.11	91.76	128.76	198.41	193.85	196.65	252.00	193.47	173.40	221.50	213.15	204.60
September	90.36	93.01	131.76	190.31	193.85	202.85	255.20	188.27	185.00	221.50	211.25	202.10
October	88.51	96.16	135.11	167.11	193.85	202.25	255.20	182.57	188.60	220.30	207.55	205.35
November	87.26	101.06	138.16	166.51	193.55	206.85	255.32	166.32	188.60	220.90	205.70	205.95
December	86.51	107.06	149.41	167.11	194.75	206.85	251.62	167.82	192.60	217.30	208.58	205.95
Averages	88.56	92.58	129.58	181.24	189.20	198.42	251.28	201.81	174.45	214.07	215.36	206.68

*1916 figures revised in accordance with survey of labor conditions in that year.

Engineering News-Record Construction Volume Index Number



	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
January	71	48	96	69	57	38	138	52	100	151	125	141
February	83	76	95	47	151	91	130	55	68	129	144	145
March	142	75	90	55	90	52	113	90	186	162	161	161
April	113	82	137	65	58	78	134	109	161	186	159	211
May	155	96	129	50	67	80	126	108	221	149	191	209
June	128	105	129	57	106	129	92	119	178	173	149	214
July	139	129	136	87	107	122	83	115	146	151	161	178
August	118	126	130	63	111	135	86	116	137	100	162	266
September	95	116	145	116	145	113	80	109	149	166	159	262
October	108	101	97	87	67	207	79	130	154	154	164	233
November	84	150	105	76	66	71	57	106	114	121	128	194
December	62	89	106	49	27	41	63	117	134	123	145	206
Yearly	107	100	119	67	86	98	99	96	147	146	154	201

Construction Cost in 1926

Part I—Materials Prices

MOST of the basic construction materials have shown little change in price during the past three or four months, at principal industrial centers throughout the country. In instances where price changes occurred, a great majority were in an upward direction. Although the general cost level is below that of a year ago, the present tendency in materials costs, based upon price movements since October, 1925, is in the direction of slightly higher levels but without abrupt advances, at least during the first quarter of the current year.

Cost of materials, generally, is about 75 per cent above the 1913 level. Skilled labor is higher, while common laborers' wages are lower, than a year ago.

The rise in materials' prices since 1913, however, has been uneven. A group consisting of yellow-pine flooring and lath, common lump lime, and paint stuffs, averages 123 per cent above 1913 prices. Another group comprising hollow building tile, reinforcing bars, structural shapes, and window glass, averages only 31 per cent above the 1913 level.

A definite upward trend is noted in the following materials: Pig-iron, except Virginia No. 2 at Philadelphia; scrap, mostly machine-shop turnings, railroad malleable, and re-rolling rails at New York; light and re-rolled rails at Pittsburgh; white and red oak, and sap pine-cypress railroad ties at St. Louis; c.-i. pipe at New York, reinforcing bars, structural rivets and steel sheets at Pittsburgh; common brick and hollow tile at New York; pine timbers f.o.b. New York, New Orleans, and St. Louis; Douglas fir timbers f.o.b. Minneapolis; soda ash and bleaching powder at producing points.

Declining tendencies are developing in the following: Portland cement at seven of sixteen mills throughout the country; hollow tile at Denver and Detroit; linseed oil, and red and white lead f.o.b. New York; cut nails at Pittsburgh mill.

Part II—Employment

THAT the building trades mechanics will be actively employed for at least another year, is evident from reports received by Engineering News-Record, *regarding the* 1926 *construction outlook in eighteen of the nation's most important industrial centers.*

Various large projects are contemplated in most of the cities, with a minimum of labor troubles and at 1925 *wage rates.*

Prospects for 1926 in the various centers, follow:

Atlanta—No changes are indicated in the 1926 building trades wage schedule. There has been a considerable movement of skilled men from Atlanta to Florida, where higher wages are available. As considerable activity is anticipated in Atlanta during 1926, the question arises as to whether the building laborers will return at the present scale of wages. The four largest jobs scheduled for 1926 are as follows: Sears, Roebuck & Co., building, $3,000,000; R. H. Macy & Co., building, $3,000,000; Whitehead office building, $350,000; Winecapp Theater building $350,000.

Boston—As regards building trades wages there appears to be no danger of increases during the coming year, with the possible exception of ironworkers. Although the present rate for ironworkers is supposed to be $1.10, there are a great many contractors paying $1.25 per hr., but not as a published fact up to this time. Without doubt the standard rate will be $1.25 per hr. in a short time.

The building outlook for the coming year appears to be exceedingly good. Architects are making sketches and preliminary plans for several projects which, though not particularly large in separate instances, will undoubtedly represent a large total.

Los Angeles—Building trades wages will remain the same with no strikes or labor troubles anticipated. Plenty of work is definitely planned for 1926.

Minneapolis—No wage reductions are likely but some employers favor certain increases in order to keep skilled mechanics from deserting to Chicago, St. Louis and other points. Among the outstanding projects to go forward in 1926, are: A $1,000,000 auditorium; University of Minnesota group, $700,000; a hotel, M. S. Baker and the Dayton Co., $1,000,000; Veterans Hospital (Fort Snelling), $1,200,000.

Montreal—Plant and factory extension is practically at a standstill. Wage reductions are anticipated in the building trades, affecting mainly painters, steamfitters, carpenters, and common laborers. Bricklayers and plasterers will continue at the old rate. Proposed projects include a new Automobile Building, $1,000,000; two apartments, over $750,000 each; a hotel, $1,500,000; and the Montreal South Shore Bridge.

New Orleans—No strikes are pending and none are anticipated. Wage schedules will probably remain at the 1925 levels, in the building trades. Trade schools are rapidly eliminating shortage of building mechanics.

The outstanding construction projects of 1926 will be: The Canal Commercial Bank, eighteen stories, $4,000,000; Pere Marquette office building, $2,000,000; the Saenger theater, $1,500,000; the new Jesuits college, $1,500,000; coffee shed and one for Board of Port Commissioners, $2,000,000.

Philadelphia—Bricklayers demand wage advance; marble setters recently received increase; stone cutters are on strike; most of the existing wage agreements expire May 1, 1926.

Despite the labor situation Philadelphia has the following proposed work in view: Eighteen schools, $12,000,000; completion of Broad St. subway, $40,000,000; re-location of Pennsylvania R.R. track, main line and suburban, new streets, bulkheads, the Schuylkill River-Broad St. subway, total program will amount to about $60,000,000 and require five years for completion; Fidelity-Mutual Life Insurance Co., office building, $1,500,000; Hahneman College and Hospital, $10,000,000.

Pittsburgh—The construction outlook for the year 1926 appears favorable. Building trades wages are somewhat uncertain. Various crafts are expected to present demands for new schedules. Among the large projects for the coming season are: General improvements at Pennsylvania R.R. terminal, $15,000,000; new schools, $3,000,000; Keystone Athletic Club building, $3,000,000; Webster Hall apartment hotel, $1,500,000; a nine-story 5th Ave. apartment, $2,000,000; Loew theater, $1,000,000; General Forbes Hotel Co. building, $1,500,000; Rowland & Clark theater, $3,000,000; Pittsburgh Pennsylvania Hotel, $5,000,000.

New York—Building trades mechanics will remain at work, pending the outcome of negotiations with the employers, regarding the recent demand of the craftsmen for wage advances of $1 to $1.50 per hr. Contracts awarded for work during 1925 were at least 4 per cent greater than for the year preceding. Proposed projects, however, show a gain of over 34 per cent, despite warnings issued by the money lenders, of danger lying in the direction of speculative excess. Among the projects proposed during the past three weeks are: A hotel, 57th St. and 5th Ave. Corp., $7,500,000; refinery, American Sugar Ref. Co., $5,000,000; high school, Queens, $3,000,000; hotel, D. A. Shulte, president, $2,500,000; office building, Court Sq. Building, Inc., $2,500,000; office building, Montague Court Corp., Brooklyn, $2,350,000.

Baltimore—This city had a splendid building year in 1925, there having been about $55,000,000 spent in new work. Labor conditions remain normal, and there is no contemplated demands for increases in wages for the coming year.

Prospects for 1926 are very good. Plans are now being prepared for some large operations, such as a department store for Hochschild, Kohn & Co., costing about $2,000,000; a hotel for Shelton Interests to cost $2,000,000; a hydro-electric plant at Conowingo, near this city, to cost about $52,000,000.

Birmingham—Present indications are that building trades wages will be advanced here during the year, owing to the fact that contractors and builders are predicting that 1926 will be the greatest building year in the history of Birmingham. On this account wages may have to be increased in order to hold sufficient labor.

There are no strikes in the Birmingham section at the present time, neither are any predicted. Few strikes occur in this section among building trades mechanics.

Many new structures of considerable size are being planned for 1926. The Tennessee Coal, Iron & Railroad Company has announced that it will spend between $10,000,000 and $15,000,000 during the year on the improvement and enlargement of its steel mills at Fairfield, a suburb of Birmingham.

Chicago—Agreements with the various Chicago building trades do not expire until June, 1926, and present wage rates will obtain until then. As usual, there have been recent rumblings of increased demands by several of the trades for a $1.50 per hr. basis, settlement of which will be attempted within the next few months.

Chicago has been remarkably free of strikes during the past year, except for a few minor affairs, and it is not anticipated, at this time, that any condition will arise to change past amicable relations.

New construction projects, outside of public improvements, promise to exceed the 1925 record. At the present time, plans are made or are under way, for over $160,000,000, estimated value, in new office, hotel, club, apartment and commercial buildings.

Cincinnati—Wages are expected to remain the same as in 1925. No strikes or labor troubles are anticipated. Some of the new buildings to be constructed in 1926 are as follows: Walnut Hills High School, $250,000; Rialto Theater and Hotel, $700,000; Nurses' Home, $200,000; American Druggists building, $600,000; State Hospital, $300,000.

Cleveland—Sustained building construction activity comparable to, or even exceeding 1925 levels, is forecast by leaders in this industry for the ensuing year. Precedents have been shattered in the building industry in the past three years and the new year holds promise of even more gigantic construction work. The total cost of building construction for greater Cleveland for 1925 was $105,000,000, this is a million dollars less than 1923, the record breaking year, and ten million more than 1924.

Dallas—Building trade schedules will be higher during 1926. Bricklayers' wages went to $13 per day last October and the carpenters scale advanced to $9, or $1 per day more, beginning Jan. 1, 1926.

There is no evidence of strikes but labor troubles are anticipated, due to various crafts attempting to raise their scales without first finishing uncompleted work, figured at the lower rates.

Houston anticipates a building program of about 20 million dollars; Dallas about the same; and Fort Worth anticipates about 25 million in construction. Plans are being drawn in Fort Worth for a $1,000,000 Medical Arts Building; a sixteen-story office building, to cost about $800,000; and approximately $2,000,000 worth of schools. The City of Fort Worth has just passed a bond issue for $6,500,000 for paving, sewer and water.

Denver—Labor conditions in the building trades in Denver and surrounding territory are favorable at the beginning of the new year. No applications for changes in wage schedules are pending at this time and the outlook for the year 1926 is especially encouraging.

Detroit—Wages in the building trades in Detroit have remained practically unchanged throughout the greater part of 1925 and no general increase in rates is looked for in 1926. No strikes or labor difficulties are anticipated, present prospects pointing to a peaceful year with plenty of work ahead.

The City Engineer has pointed out the immediate need of over $2,500,000 for relief of present sewers. The amount needed for the year 1926-7 is estimated at $6,164,000.

St. Louis—With all previous biulding records shattered in 1925 by a total over $54,551,000, St. Louis is facing the future with confidence. Present indications are that 1926 will be another banner year.

In 1924 the total for the entire year was $39,831,639, while in 1923, the previous record year, the total building operations for the twelve-month period was $41,443,755.

Seattle—The first week of the new year in Seattle and Puget Sound district started with an active building program; mild weather encouraging an early start. The outlook for winter and early spring is exceptionally bright. Twenty new buildings in Seattle already announced call for a twelve million dollar expenditure. Unemployment is at its peak in the cities of the Northwest but the situation is less serious than last year.

Spring Prices of Materials 1913 to 1925

THE months of April, May and June, each year from 1913 to 1925, are used in the following comparison of spring construction materials prices, as published annually in *Engineering News-Record* since 1919.

These three months are used for the reason that congestion in building materials shipments as well as increased activity in construction are obviously greater then than at any other time of the year.

Mid-December (1925) prices on all of the materials except steel shapes, reinforcing bars, and sheetpiling at mill and reinforcing bars and linseed oil at New York warehouses, were considerably above the average of spring prices from 1913 to 1925.

Since 1923 the general trend has been marked by increasingly smaller excesses, each year, of advances over declines.

Comparing the spring of 1925 with that of the year preceding, we find that linseed oil is the only material in the table to show an advance in price; the gain in this case amounting to 15 per cent. Cement at Chicago, crushed stone at New York and freight rates on steel from Pittsburgh to New York remained unchanged. All of the other materials declined.

The present trend is upward in lumber and cast-iron pipe quotations; downward in linseed oil prices and wages of common laborers, while the following materials show signs of considerable stability: cement, brick, aggregates, steel (bars, shapes and plates), sheetpiling, and clay products.

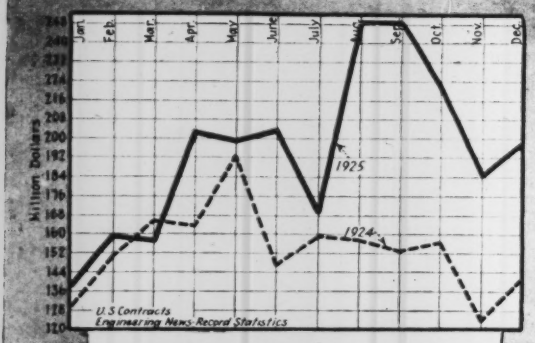
The usual spring rush, plus the active Florida demand for building materials may develop a slight upward tendency in spring prices for 1926.

Engineering News-Record Comparison of Spring Construction Materials Prices Since 1913

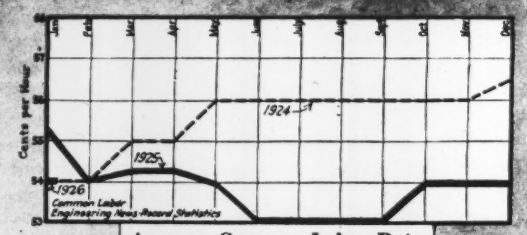
(All Prices F.O.B. New York Except Otherwise Stated)

	Portland Cement, per bbl. *net, without bags*, f.o.b. Chicago	Southern Pine, 3x12 to 12x12, 20 ft. and Under, per M ft.	Common Brick (per M.)	Crushed Stone (per Cu. Yd., 1 In.)	Sand (per Cu. Yd.)	Gravel (per Cu. Yd., 1-In.)	C.-I. Pipe (6-In. per Ton)	Beams and Channels (3-15-In. per 100 lb.)	Beams, Etc. Pittsburgh Mill	Reinforcing Bars, 1-In. and Larger Pittsburgh Mill	Bars, 1-In. and Larger	Steel Sheetpiling, Pittsburgh Mill	Tank Plates, 1-In. and heavier per 100 lb.	Hollow Tile (10x12x 12 per Block), Factory Perth Amboy, N. J.	Linseed Oil per gal. (Raw in 5-bbl Lots)	Freight to Pittsburgh on Steel (per 100 Lb.)	Average Common Labor Rate per Hr. for U. S.
April, 1913	$1.19	$28.50	$7.00	$0.90	$0.50	$0.85	$24.00	$2.15	$1.70	$1.50	$2.25	$1.60	$1.61	$0.052	$0.48	$0.16	$0.17
May, 1913	1.19	28.50	7.00	.90	.50	.85	23.50	2.15	1.65	1.50	2.25	1.60	1.61	.052	.50	.16	.17
June, 1913	1.19	28.50	7.00	.90	.50	.85	23.00	2.15	1.50	1.50	2.25	1.60	1.61	.052	.48	.16	.17
Average	$1.19	$28.50	$7.00	$0.90	$0.50	$0.85	$23.50	$2.15	$1.62	$1.50	$2.25	$1.60	$1.61	$0.052	$0.49	$0.16	$0.17
April, 1914	$1.12	$28.50	$5.50	$0.95	$0.50	$0.90	$22.00	$1.95	$1.15	$1.20	$2.25	$1.60	$1.31	$0.06	$0.54	$0.16	$0.18
May, 1914	1.12	30.00	5.50	.95	.50	.90	22.00	1.85	1.15	1.15	2.25	1.60	1.31	.06	.54	.16	.18
June, 1914	1.12	30.00	5.60	.95	.50	.90	20.50	1.85	1.10	1.15	2.25	1.60	1.31	.06	.53	.16	.18
Average	$1.12	$29.50	$5.55	$0.95	$0.50	$0.90	$21.50	$1.85	$1.13	$1.17	$2.25	$1.60	$1.31	$0.06	$0.54	$0.16	$0.18
April, 1915	$1.11	$28.50	$5.50	$0.90	.....	$0.85	$20.00	$1.90	$1.15	$1.15	$1.95	$1.60	$1.36	.....	.....	$0.169	$0.18
May, 1915	1.11	28.50	5.75	1.05	.....	.85	20.50	1.90	1.20	1.15	2.00	1.50	1.32	.....	.....	.169	.18
June, 1915	1.15	26.50	6.00	1.05	.....	.85	22.00	1.90	1.20	1.20	2.00	1.50	1.37	.....	.....	.169	.18
Average	$1.12	$27.75	$5.75	$1.00	.....	$0.85	$20.75	$1.90	$1.18	$1.17	$1.97	$1.53	$1.35	.....	.....	$0.169	$0.18
April, 1916	$1.42	$31.50	$8.50	$0.95	$0.40	$0.80	$30.50	$2.50	$2.50	$2.45	$3.10	$2.50	$2.50	$0.125	$0.81	$0.169	$0.18
May, 1916	1.46	31.50	7.25	.95	.40	.85	30.50	2.50	2.75	2.50	3.25	2.50	2.65	.125	.81	.169	.18
June, 1916	1.46	30.50	8.00	.95	.50	1.00	30.50	2.60	2.75	2.50	3.10	2.50	2.75	.125	.73	.169	.18
Average	$1.45	$31.00	$7.90	$0.95	$0.45	$0.90	$30.50	$2.55	$2.67	$2.47	$3.15	$2.50	$2.65	$0.125	$0.78	$0.169	$0.18
April, 1917	$1.76	$32.75	$9.50	$1.20	$0.50	$1.25	$47.50	$3.75	$3.88	$3.35	$4.60	$3.60	$5.00	.185	$1.04	$0.169	$0.28
May, 1917	1.90	34.75	11.50	1.25	.50	1.35	55.50	3.80	4.00	3.50	.....	3.60	5.50	.185	1.21	.169	.28
June, 1917	1.91	39.75	10.25	1.25	.50	1.25	55.50	5.00	4.31	3.50	5.10	3.60	7.00	.....	1.31	.169	.28
Average	$1.86	$35.75	$10.40	$1.25	$0.50	$1.30	$51.70	$4.15	$4.06	$3.45	$4.85	$3.60	$5.80	$0.185	$1.19	$0.169	$0.28
April, 1918	$1.96	$42.75	$10.25	$1.75	$1.25	$2.00	$55.35	$4.20	$3.00	$2.90	$4.09½	$3.10	$4.45	$0.20	$1.55	$0.195	$0.37
May, 1918	1.96	42.75	10.00	1.75	1.25	2.00	55.35	4.20	3.00	2.90	4.09½	4.00	4.45	.20	1.55	.195	.37
June, 1918	2.00	43.25	10.25	1.75	1.25	2.00	61.35	4.20	3.00	2.90	4.09½	4.00	4.45	.20	1.58	.195	.37
Average	$1.97	$43.00	$10.15	$1.75	$1.25	$2.00	$57.35	$4.20	$3.00	$2.90	$4.09½	$3.70	$4.45	$0.20	$1.56	$0.195	$0.37
April, 1919	$2.00	$45.00	$15.00	$1.75	$1.25	$2.00	$57.70	$3.47	$2.45	$2.35	$3.37	$2.55	$3.67	$0.2263	$1.55	$0.27	$0.46
May, 1919	2.00	45.00	15.00	1.75	1.25	2.00	57.70	3.47	2.45	2.35	3.37	2.55	3.67	.2263	1.63	.27	.45
June, 1919	2.00	46.00	15.00	1.75	1.25	2.00	52.70	3.47	2.45	2.35	3.37	2.55	3.67	.2268	1.76	.27	.45
Average	$2.00	$45.50	$15.00	$1.75	$1.25	$2.00	$56.03	$3.47	$2.45	$2.35	$3.37	$2.55	$3.67	$0.2264	$1.65	$0.27	$0.45
April, 1920	$2.00	$72.00	$18.00	$2.00	$1.25	$2.25	$72.30	$5.00	$4.00	$4.00	$5.00	$3.65	$5.00	$0.4263	$1.87	$0.27	$0.55
May, 1920	2.08	70.00	18.00	2.15	1.50	2.50	76.30	5.00	4.00	4.00	5.00	3.65	5.00	.4263	1.87	.27	.57
June, 1920	2.15	70.00	18.00	2.15	1.50	3.00	76.30	4.47	4.00	3.75	5.00	3.65	4.67	.....	1.73	.27	.58
Average	$2.08	$70.50	$18.00	$2.10	$1.42	$2.58	$74.97	$4.83	$4.00	$3.92	$5.00	$3.65	$4.89	$0.4263	$1.83	$0.27	$0.57
April, 1921	$2.17	$48.00	$16.00	$1.95	$1.25	$2.50	$63.30	$3.33	$2.00	$2.00	$3.28	$2.55	$2.00	.....	$0.73	$0.38	$0.56
May, 1921	2.17	48.00	15.00	1.95	1.25	2.50	63.30	3.33	2.20	2.10	3.38	2.55	2.40	.....	.67	.38	.57
June, 1921	2.17	43.00	14.50	1.95	1.25	2.50	58.30	3.33	2.20	2.10	3.38	2.55	2.40	$0.2055	.80	.38	.58
Average	$2.17	$46.25	$15.00	$1.95	$1.25	$2.50	$61.60	$3.33	$2.15	$2.10	$3.35	$2.55	$2.25	$0.2055	$0.73	$0.38	$0.57
April, 1922	$1.97	$44.00	$16.25	$1.75	$1.00	$1.75	$47.30	$2.48	$1.50	$1.50	$2.58	$1.75	$2.48	$0.2105	$0.83	$0.38	$0.43
May, 1922	1.97	43.00	17.00	1.75	1.00	1.75	47.30	2.58	1.60	1.60	2.68	2.00	2.58	.2105	.91	.38	.42
June, 1922	1.97	43.00	20.00	1.75	1.00	1.75	49.30	2.58	1.60	1.60	2.68	2.00	2.58	.2105	.91	.38	.43
Average	$1.97	$43.33	$17.75	$1.75	$1.00	$1.75	$47.97	$2.55	$1.57	$1.57	$2.65	$1.92	$2.55	$0.2105	$0.88	$0.38	$0.43
April, 1923	$2.20	$58.00	$20.00	$1.75	$1.00	$2.25	$57.50	$3.44	$2.45	$2.35	$3.34	$2.50	$3.44	$0.2905	$1.13	$0.34	$0.50
May, 1923	2.20	60.00	20.00	1.75	1.25	2.25	58.50	3.44	2.50	2.40	3.34	2.60	3.44	.3505	1.16	.34	.51
June, 1923	2.20	60.00	20.00	1.75	1.25	2.25	63.00	3.64	2.50	2.40	3.54	2.65	3.64	.3505	1.16	.34	.53
Average	$2.20	$59.33	$20.00	$1.75	$1.16	$2.25	$59.66	$3.50	$2.48	$2.38	$3.40	$2.58	$3.50	$0.3305	$1.15	$0.34	$0.51
April, 1924	$2.20	$59.00	$20.00	$1.85	$1.25	$2.00	$62.60	$3.64	$2.45	$2.40	$3.54	$2.65	$3.64	$0.2442	$0.95	$0.34	$0.54
May, 1924	2.20	58.00	20.00	1.85	1.25	1.75	62.60	3.59	2.38	2.33	3.49	2.45	3.59	.2786	.95	.34	.56
June, 1924	2.20	54.00	20.00	1.85	1.00	1.75	62.60	3.59	2.28	2.25	3.49	2.38	3.59	.2786	.98	.34	.56
Average	$2.20	$57.00	$20.00	$1.85	$1.16	$1.83	$62.60	$3.60	$2.37	$2.32	$3.50	$2.49	$3.60	$0.2671	$0.96	$0.34	$0.55
April, 1925	$2.20	$56.00	$15.00	$1.85	$1.00	$1.75	$53.10	$3.34	$2.05	$2.15	$3.24	$2.20	$3.34	$0.252	$1.14	$0.34	$0.54½
May, 1925	2.20	55.00	15.00	1.85	1.00	1.75	53.10	3.34	2.00	2.00	3.24	2.20	3.34	.252	1.07	.34	.54
June, 1925	2.20	54.00	15.50	1.85	1.00	1.75	51.00	3.34	2.00	2.00	3.24	2.28	3.34	.252	1.09	.34	.53
Average	$2.20	$55.00	$15.17	$1.85	$1.00	$1.75	$52.40	$3.34	$2.02	$2.05	$3.24	$2.23	$3.34	$0.252	$1.10	$0.34	$0.53½
General average	$1.81	$44.03	$12.89	$1.52	$0.95	$1.65	$47.73	$3.19	$2.36	$2.26	$3.31	$2.50	$3.15	$0.2117	$1.07	$0.257	$0.38½
Dec. 17, 1925	$2.10	$57.00	$15.25	$1.85	$1.00	$1.75	$51.60	$3.34	$1.95	$2.05	$3.24	$2.30	$3.34	$0.252	$0.93½	$0.34	$0.54

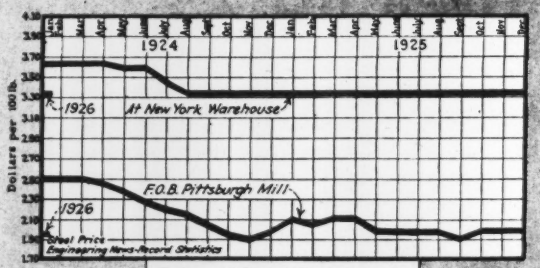
Monthly Statistics of the Construction Industry



Contracts Awarded in the United States
Reported in E. N.-R.

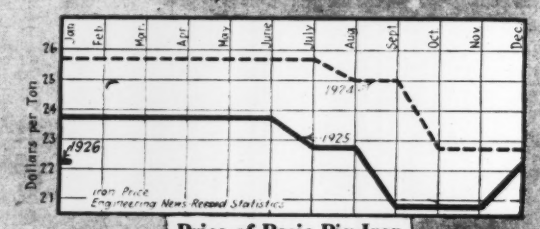


Average Common Labor Rate
Pick and Shovel Men

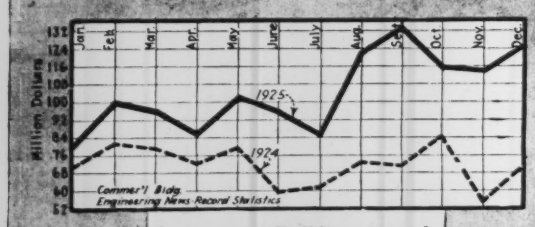


Price of Steel Structurals
Shapes 3-In.; Plates ¼-In.

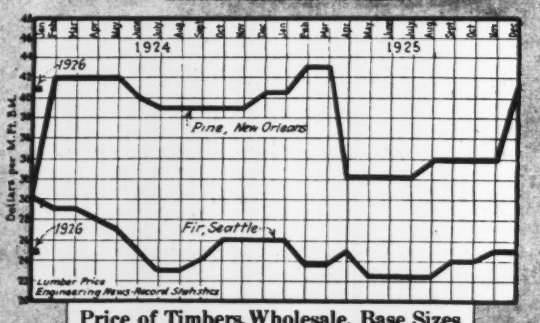
Industrial Building Awards
$40,000 and Over



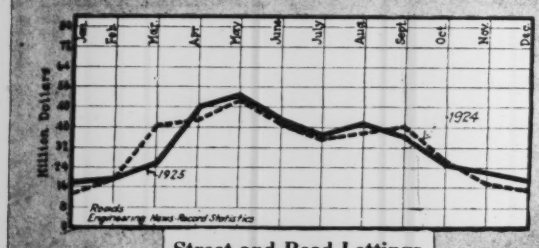
Price of Basic Pig Iron
F.o.b. Pittsburgh



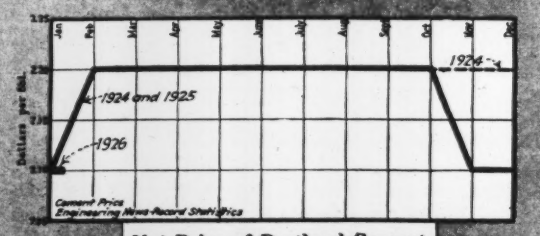
Commercial Building Awards
$150,000 and Over



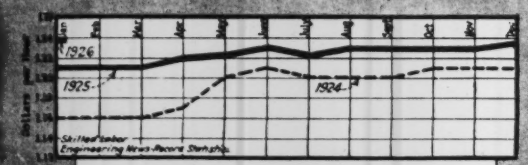
Price of Timbers, Wholesale, Base Sizes
Car Lots to Contractors



Street and Road Lettings
$25,000 and Over

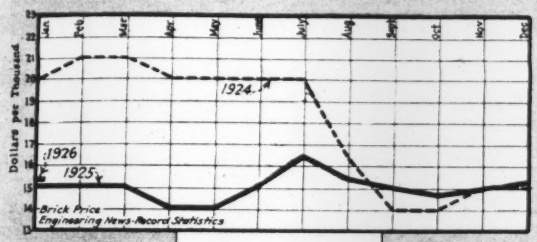


Net Price of Portland Cement
Car Lots, F.o.b. Chicago

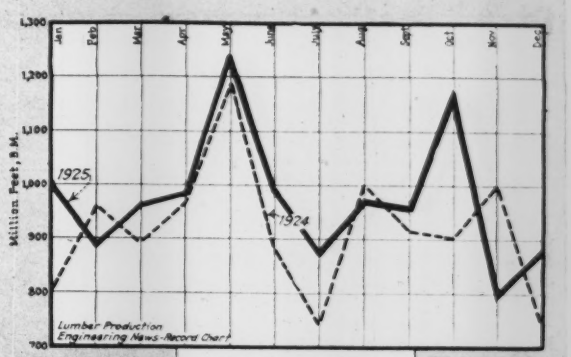


Average Wage of Skilled Building Trades
Bricklayers, Carpenters and Steel Erectors

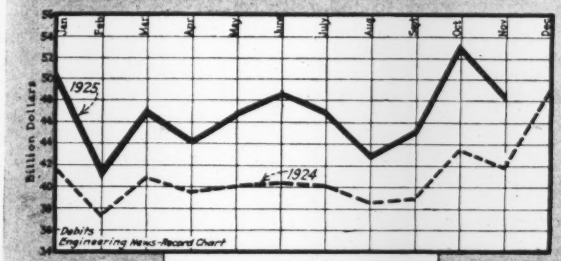
Monthly Statistics of the Construction Industry



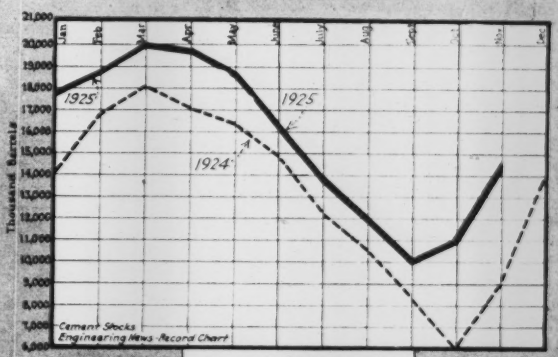
Price of Brick
At Dock, New York



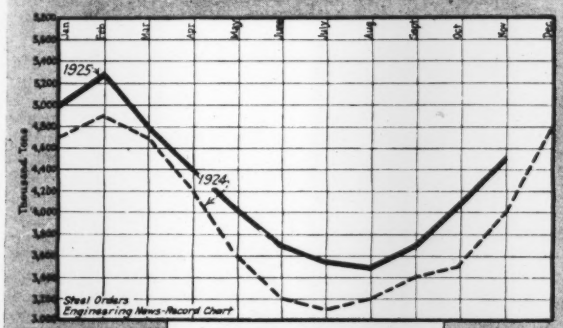
Lumber Output
Nat. Lumber Mfrs. Assn.



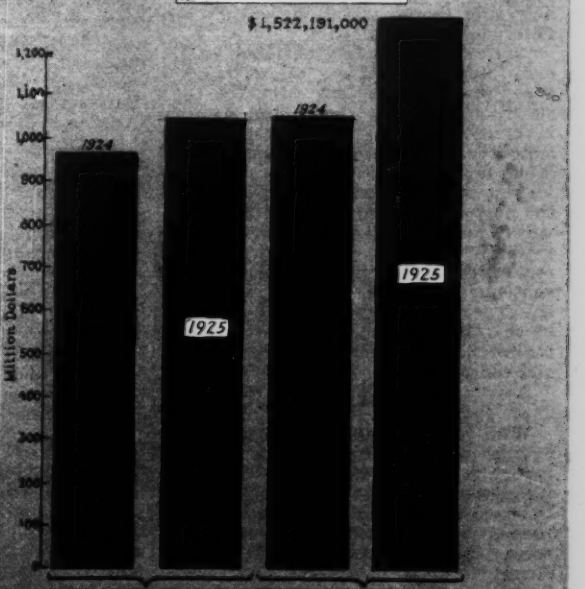
General Business Trend
Bank Debits—Federal Reserve



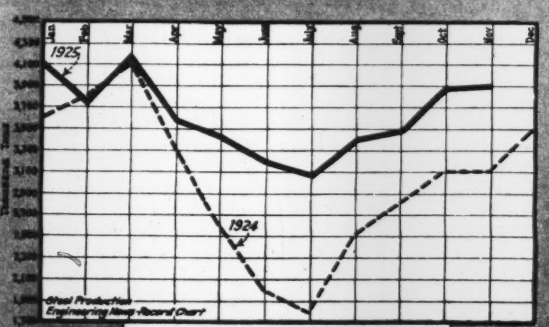
Cement Mill Stocks
Geological Survey



Unfilled Tonnage
On Books of U. S. Steel Corp.



Public—Contracts—Private
Jan. 1 to Dec. 31
Reported by E. N.-R.



Steel Ingot Output
Gross Tons; Am. Iron and Steel Inst.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Outlines Official Policy on Colorado River

Interior Department Report Favors Construction of Storage Dam and Canal

The administration has outlined its Colorado River policy in a report made by the Secretary of the Interior on the Swing-Johnson bill. The report was made, it is understood, after Secretaries Work and Hoover had discussed the matter at length with the President.

The report recommends the construction, with federal funds, of a dam in the Colorado River to be 550 ft. high, which will create a reservoir of 26,000,000 acre-ft. capacity. The All-American canal, connecting the Colorado River with the Imperial and Coachella valleys, is held to be an essential part of the plan.

The electrical energy which will be developed in connection with the project should be sold at the switchboard to the highest bidder, the report says. The purchasers of the power will be in entire charge of distribution and they must provide their own transmission lines. A unified power plant, Dr. Work contends, is better than the allocation of power privileges as proposed in the Swing-Johnson bill. Joint use of trunk transmission lines, it is pointed out, is no longer an experiment.

The benefits of the development under the administration plan are to be available only to the states that ratify the Colorado River Compact.

"Interstate and international rights and interests involved, the diversified benefits which will flow from the construction of these works, the waiting necessities of cities for increased water supplies, the large development of latent agricultural resources, the protection of those already developed and the immense industrial benefits which will come from the production of cheap power," says the report, "appear to render desirable the construction and subsequent control of these works by the federal government. All uses can be co-ordinated and the fullest benefits realized only by centralized ownership and control."

Sale of Water

With regard to the sale of water for agricultural and municipal purposes the report says: "In the case of water to irrigation districts and municipalities the prices of water should be such as to repay all operating expenses and return the money expended on the All-American canal within the period fixed in the Reclamation Act and under its conditions."

On the questions of the Imperial Valley and its relation to Mexican lands it is stated that the necessity for the All-American canal and the size and cost

(*Concluded on p. 96*)

"Highest Signal in the World"

In our issue of Nov. 12 we published the following extract from *Engineering News* of November, 1875, under the heading of "Engineering Fifty Years Ago":

> A new surveying signal has lately been erected on the summit of Mount Shasta, California, by the Coast Survey Department. The signal is a hollow cylinder of galvanized iron, twelve feet high and two and a half feet in diameter, surmounted by a cone of nickel plated copper, with concave sides, three feet high and three feet in diameter at the base; and its altitude is, according to the observations taken by the members of the Coast Survey, 14,402 feet.

SURVEYING MONUMENT ON MT. SHASTA

Recently, we received from W. H. Kirkbride, engineer of maintenance-of-way and structures, Southern Pacific Co., three interesting photographs of this signal, two of which are reproduced herewith. The upper photograph was taken in 1899 and shows the monument still standing on the summit of the mountain but badly out of plumb. The lower picture, which was taken recently, shows the monument lying partly buried in snow some distance below the summit.

Contractors Not Compelled to Pay Current Rates

Supreme Court Finds Oklahoma Wage Law Unconstitutional—It is Declared Too Vague

In a decision read by Justice Sutherland, the United States Supreme Court, on Jan. 4, declared unconstitutional the Oklahoma state law which sought to compel contractors on state work to pay certain wages for an eight-hour day. The law is so vague as to make it impossible for citizens to properly defend themselves against its indefinite terms, the Court ruled, affirming an interlocutory injunction granted by the federal district court to the General Construction Co. against Claude C. Connolly, state commissioner of labor, and other officials.

The law in question provided an eight-hour day on state work and to persons engaged in work on behalf of the state, seeking to include contractors and subcontractors having state contracts in its terms. It also provided that "not less than the current rate of per diem wages in the locality where the work is performed shall be paid to laborers, workmen, mechanics and other persons employed" by the state or in behalf of it. A fine of $50 to $500 or imprisonment from three to six months was provided for violations of the act.

The General Construction Co. had contracts for bridge construction from the state. The Commissioner of Labor notified the company it was not paying wages paid by others in the locality, although, the Supreme Court notes, the wages paid by the company were satisfactory to the employees. The company paid laborers $3.20 a day, and the commissioner said laborers in the locality were receiving $3.60. The Supreme Court found that laborers in the locality were paid varying amounts and held that the law was unconstitutional because the term "locality" cannot be defined definitely and the term "current rate of wages" does not "denote a specific sum, but maximum, minimum and intermediate, varying from time to time, and dependent upon the class of work done."

Twelve Bidders for Arlington Memorial Bridge Work

Bids for the construction of the piers and abutments of the Arlington Memorial Bridge across the Potomac River at Washington, D. C., were opened on Jan. 7. Twelve concerns put in bids. They ranged from that of H. P. Converse, of Boston, of $1,299,000 to build the piers and abutments in 550 days using the cofferdam method of construction, to that of the Missouri Valley Bridge & Iron Co. of Leavenworth, Kan., of $3,022,000 to do the work in 730 days by the caisson method.

Engineering Fifty Years Ago

From *Engineering News*, January, 1876

A Review of Engineering in the United States and Abroad for 1875

THE past year has been one of depression in business, the stagnation in all branches of trade and manufactures having perhaps been greater than during 1874. Many schemes for improvements have therefore languished, and there is less of note and novelty to record than usual. We will endeavor to mention some engineering works which occur to us, not making, by any means, an exhaustive catalogue.

Our contemporary, the *Railroad Gazette*, always presents us with very full statistics in regard to American railroads. Let it suffice then to note that the added mileage to our railroad system is still less than for the preceding year. Very few new roads have been in progress, and much of the increase comes from small branches, added tracks, and other extensions on old roads. The amount of new track has been 1,300 miles, as against about 1,900 miles in 1874, 3,420 in 1873, and 6,700 in 1872.

* * *

The new grade of the Harlem Railway, from the Grand Central Depot to Harlem River, a distance of about 4 miles, was completely opened for trains in June. Arched brick tunnels, flat-top beam tunnels and open cuts alternate, as the level of the surface requires.

* * *

The Greenwich St. Elevated Ry. has been extended to 86th St., and will be further extended to Great Central Depot. It is now constructed with plate girders, and wrought-iron cluster columns, on a brick foundation, at the line of the street curb.

* * *

Work was resumed in August on the East River Bridge. The Brooklyn pier is finished, height 271 ft. above tide; the Brooklyn anchorage is almost ready for cable laying; the New York pier is up some 200 ft., and the anchorage is fairly under way. The New York Dock Improvement goes steadily forward. Concrete is here employed in large masses.

* * *

A new tunnel under the Bergen Hill, New Jersey, 4,500 ft. long, is being rapidly advanced. The Musconetcong Tunnel, on the Easton and Amboy R.R. in New Jersey, was completed in the early part of 1875, although the headings met Dec. 16, 1874. Its length is a little less than one mile.

* * *

The famous Wooden Portage Bridge, on the Erie Railway, over the Genesee Falls, was destroyed by fire and replaced by an iron one, 800 ft. long. A new iron bridge across the Missouri, at Atchison, Kansas, highway and railroad, was completed Aug. 4. It has a draw-span of 382 ft. and three fixed spans of 269 ft. each. A new suspension bridge is under contract for the Monongahela River, near Pittsburg.

* * *

Capt. Eads, having contracted with the U. S. Government to make a navigable channel for our largest vessels at the mouth of the Mississippi, commenced his work of improvement June 14. He is building two jetties, composed of a combination of willow mattresses and stone, guided to place by piling, a modification of methods long in use in Holland and elsewhere. The width between the jetties at their outer ends will be 1,000 ft. The work has been demonstrated, and a manifest improvement has already been made.

* * *

The tunneling of the Detroit River is still mooted despite the abandonment of the work at Detroit. Soundings have been taken by the Canada Southern Ry. with favorable results, and plans have just been completed for a crossing at Grosse Isle.

* * *

The floor of timber packed with concrete, for the Sault Ste. Marie lock which was commenced in 1873, has been under construction. The lock will be 515 ft. long, 80 ft. wide in the chamber, 60 ft. at the gates, and have 16 ft. of water at the miter sills. The United States Engineers have been prosecuting their experiments the past year with torpedoes, as offensive as well as defensive weapons of war. They have also been engaged in another Isthmus Survey.

A Review of Engineering Abroad for 1875

In continuation of our remarks of last week upon the progress of engineering in the United States, let us take a survey of what has been accomplished or initiated in other countries.

Since the successful completion of the Mont Cenis and some other lesser tunnels, the projectors of new enterprises seem not to shrink from any obstacle. The St. Gothard tunnel, to be when completed 48,936 ft. in length, has been rapidly advanced; the headlings, 8 ft. 3 in. by 8 ft. 3 in., driven from each end, are in some 14,000 ft., but the enlargement to full size is very much behind. Profiting by previous experience, the contractors use machinery and powerful explosives to the best advantages, and it is thought that the tunnel will be finished in 1879 or 1880. A tunnel under the Severn is being carried forward by the great Western Railway Co. It will be about 4½ miles long, one-half of which length will be under the river. A bridge of 3,960 ft. across this same river was also commenced in June.

There is a scheme, which is regarded with favor, for crossing the Mersey, between Liverpool and Seacombe, by means of an iron tunnel to be sunk at the bottom of the river in a previously excavated trench. Some experiments, as to the practicability of making the joints under water between successive sections, have demonstrated that there is no unsurmountable difficulty in the way.

* * *

As the population and manufactories increase along the rivers from which many places take their water, and into which all the drainage flows, the pollution of the natural water courses calls loudly for a remedy. Royal commissions and Parliament by enactments have again the past year endeavored to protect the public health; the satisfactory disposal of sewage is a difficult problem, and the branch of Sanitary Engineering is calling to its service some of the best engineering talent abroad. Such a task is already beginning to confront the larger cities in this country, and our engineers must hold themselves prepared for the occasion. A mere enumeration of the different methods advocated, and experimented with in England with varying success, will show how pressing is the need. There may be mentioned the phosphate Sewage Co.'s process, the Native Guano or A. B. C., Gen'l. Scott's lime and cement process, Hope's irrigation, Bailey Denton's intermittent downward filtration, and Capt. Liernur's or the pneumatic system.

* * *

The celebration of the fiftieth anniversary of the opening of the Stockton and Darlington Railway, the first public railway worked by steam, took place Sept. 27. It was thought a curious coincidence that the announcement was made by telegram at the dinner, of the signing of the contract for the first Chinese railway, and that the first rails would be rolled for it that afternoon at Stockton. The introduction of railroads in the Chinese Empire it is suggested, will open a new field for engineers, but it is probable that Chinese conservatism will make their extension very gradual.

RANDOM LINES

From a Florida Notebook

He was only a year out of engineering school and he wasn't even as much of an engineer as that would indicate, so the chief engineer of the big development said, but the president of the realty company had hired him at $60 a week and one of the lots if he stayed out his year's contract. The chief engineer couldn't use him but he couldn't get rid of him under the contract. He stayed out his year, quit and sold his lot for $5,200. The next day another realtor offered him $80 a week and he had that job only two weeks when one more of the developers took him at $100 a week. Not bad for a cub, $8,320 for a year's work, and a $100 a week job at the end.

* * *

Digging one of the drainage ditches (alias Venetian Canals) some of the workmen unearthed an alligator. They got him out safely and chained him by the neck to a nearby tree. The next morning they found him dead, choked by his struggles to escape. One of the colored boys on the job came up and looked at him and then he said: "Well! Well! When 'at ole 'gater come up and he see wha's happnin' to Florider, he jus' nachully killed hisself."

* * *

I was strolling among the palmettos and drainage ditches while the chief engineer was busy in his office. One of the ubiquitous real estate salesmen approached and commenced to do his stuff. He was good but I had become hard boiled after 10 days in South Florida. He waxed enthusiastic, he waved his arms. The greatest buy in Florida. Double your money in a month. He paused and his eye caught my Am. Soc. C. E. badge. "What's that," he said. I told him. "Are you an engineer?" I admitted it. "Oh, Hell!" he said disgustedly and turned away for fairer game.

* * *

One of the signs of the native (meaning anyone who has been in Florida a week) is to speak familiarly of "The Dixie." It's "The Dixie Highway" only to newcomers.

* * *

Seen along "The Dixie" near Hollywood:

THE GOLDEN RULE REAL ESTATE AGENCY
The Rev. Samuel L. Allen

* * *

In Miami there are two Muscle Shoals real estate shops, with all the old come-on pictures of mammoth plants out of which pour thousands of workmen. Where the sugar is the flies will flock.

* * *

The chief engineer and principal assistant of one of the developments got tired of paying $10 a day each for a room in the decidedly second rate hotel at West Palm Beach, so they hired a furnished 5-room bungalow from December to April. The building must have cost all of $3,000, the lot was 50 x 100 ft. The furnishings might have run up to $1,000. It is going to cost them only $3,500 for the five months.

* * *

Extract from typical blurb: "Real wonder is felt when one beholds long freight trains sent away from Jacksonville as second and third sections of 60-miles an hour passenger trains on the 400-mile dash to Miami." Maybe! Maybe! But it took me 25 hours to make that "dash." And the 13 hours over schedule weren't spent in one spot. The train just loitered.

* * *

Long ago I came to the conclusion that the realtor was the lowest order of human life. After two weeks in Florida, I am going to start a movement to make the selling of real estate on commission a capital offense.

F. C. W.

Brooklyn Polytechnic Institute Inaugurates New President

Dr. Parke Rexford Kolbe, formerly president of the Municipal University of Akron, Ohio, was inaugurated as president of The Polytechnic Institute, Brooklyn, N. Y. on Jan. 13, 1926. Dr. Kolbe is a graduate of Buchtel College in the class of 1901. In 1919 he served as a member of the Federal School Survey Commission to the Hawaiian Islands, and in 1922 as head of the U. S. Bureau of Education's Survey Commission, University of Arizona.

New Passenger Terminal for Buffalo, N. Y.

After several years of negotiation the city of Buffalo and the New York Central R.R. Company have reached an agreement providing for a new passenger terminal. Work is to be begun in the spring and the total expenditures involved may exceed $15,000,000.

Road Construction District Law Found Unconstitutional

Because it provides no tribunal to which protests may be made or by which benefits of property are to be determined, the Texas State law authorizing counties and other political subdivisions to create road construction and improvement districts, issue bonds not exceeding one-fourth of the value of real estate within their boundaries, and assess taxes for ultimate payment of such bonds and other costs, was declared unconstitutional by the United States Supreme Court, Jan. 4, in a decision rendered by Justice Butler. The case was brought by property owners of Archer County, Tex., against the county commissioners to test the law. The lower court dismissed the petition. The Supreme Court reverses this decision and in its decree declares the law obviously unconstitutional.

Turkish Government Will Train Young Engineers

The Turkish Government has entered twenty-five students in Robert College, Constantinople, to study engineering at the expense of the government. This is the first time that the Turkish Government has defrayed the expenses of students at either of the American colleges in Constantinople, and is in line with the policy of the Young Turks to modernize their country.

These twenty-five student engineers, when trained, will set about installing sewage systems, water and electric lighting systems and other modern conveniences in towns in the interior of Turkey. During recent years the engineering staff of Robert College has served as a consulting bureau, without fee.

Outlines Official Policy on Colorado River

(*Concluded from p. 91*)

of this canal depend largely on whether the existing concession, under which water now is diverted from the Colorado and carried through Mexico to the Imperial Valley, can be modified. If it cannot be the All-American canal becomes an indispensable part of the project. If the government of Mexico would consent to a modification of the concession and limit definitely the volume of water to which Mexican irrigators would be entitled, then the future use of the present canal would be economical and desirable. The All-American canal could be made smaller and used mainly for the irrigation of the higher lands in the Imperial and Coachella Valleys.

"As the Mexican irrigators are in the upper end of the present canal, the pinch of scarcity when it has come in the past or when it may come in the future falls first on irrigators in the United States, the country which supplies all of the water, all of the construction cost and all of the money advanced for operation. It is unfair to California irrigators now and will be even more unfair after the reservoir is provided."

The reservoir in Boulder Canyon, it is reported, will cost $41,500,000. To develop 1,000,000 hp. of electrical energy is estimated to cost $31,600,000. The cost of the All-American canal is placed at $31,000,000.

The main source of revenue will be the sale of power. Wholesale prices of power in the west now range from 3½ miles to 8 miles per kw.-hr. at the switchboard. Assuming that only three mills to 8 mills per kw.-hr. at the amount to $10,800,000 annually, it is calculated, as 3,600,000,000 kw.-hr. would be generated. Storage and sale of water for irrigation and domestic purposes would net $1,500,000. Operation, maintenance and fixed charges would be $6,000,000 annually, Dr. Work says. Repayment of the entire federal expenditure therefore would be possible in twenty-five years.

It is recommended further that the construction work be placed in the hands of the Reclamation Bureau.

Metcalf & Eddy Lose Income Tax Suit on Appeal

The United States Supreme Court, in the Metcalf & Eddy income tax suit, brought as a test case in behalf of consulting engineers for municipalities and states, sustained the lower court decision on Jan. 11, which was against the original plaintiffs. In its application to engineers in general the Supreme Court holds that consulting engineers who perform services for a state or one of its subdivisions without a definite term or an oath of office and who are free to undertake other employment simultaneously are not ordinarily officers or employees of the state or its subdivision within the meaning of the exemption clause in the federal revenue act, and hence their income from such services is taxable by the United States Government. The court, however, in its opinion rendered by Justice Stone, made plain that it is difficult to set down an inflexible rule because conditions might vary widely.

The decision was rendered in a suit brought by Leonard Metcalf and Harrison P. Eddy, consulting engineers of Boston, against certain assessments of income tax under the act of 1917 against the partnership of Metcalf & Eddy. Twenty items of income received as consulting engineers for water and sewerage systems were involved. The lower courts held that in two cases one of the partners was an officer of a political sub-division but that the tax should be collected in the other 18. Both sides appealed but the government did not press its appeal and the decision affirms the lower courts.

In the 18 cases the court held that the engineers were not employees but independent contractors. On the constitutional question, the decision held that the tax did not interfere with the ability of the engineers to discharge their obligations to the state or a subdivision and that it did not affect the ability of the state or its subdivisions to procure the services of private individuals; therefore no constitutional prohibition was violated.

The decision in the trial court was printed in full in *Engineering News-Record*, Oct. 9, 1924, p. 581.

Attempts to collect Federal income taxes from engineers and others, who, so far as the above definition of a regular city official goes, are unquestionably such, are still being made by the Commissioner of Internal Revenue, on the ground that water supply is not a government function (see editorial, *Engineering News-Record*, Aug. 13, 1925, p. 251.) Committees of the American and New England Water Works Association, and the corporation counsels of some cities, are looking out for the interests of waterworks men in this respect, and may be represented in the forthcoming argument on the appeal now pending in the Supreme Court in the case of employees of the Detroit municipal street railway.

Steamer Wrecks Swing Span of Oakland Estuary Bridge

The 350-ft. swing span of the Webster St. bridge across Oakland (Calif.) Estuary was knocked endwise off its supports on Jan. 7 when struck by the freight steamer Lancaster of the Isthmian Line. Fortunately the span lies almost exactly in the fully open position and thus only slightly impairs the clearance of the Oakland inner harbor channel entrance. The span had been opened some minutes earlier to allow another boat to pass and was still open awaiting the Lancaster as it approached. The cause of the collision has not yet been established.

The span was struck squarely on its east end, and the steamer ploughed about two panels into the steelwork, shoving this end more than 40 ft. out of position, thrusting the central tower off the swing pier and forcing the extreme westerly end up onto the protection dolphin. The east arm was badly damaged, and piling may be necessary for raising and reconstructing this arm, in which as many as half the members may have to be replaced. The west arm was not very seriously damaged, and with the aid of barges might be lifted back to its supports for rehabilitation.

The bridge was the most important link between Oakland and Alameda, carrying street car, vehicular and pedestrian traffic, all of which must now go two miles east to reach other bridges. The War Department in 1916 ordered the removal of this structure, but stays in the order had been obtained. The estuary vehicular tunnel will not be completed for at least two years and the need of a bridge at this point is urgent.

Contracts Let for Large Railway Terminal Improvement

The Norfolk & Western Railway Co. has let contracts for extensive improvements in its terminal facilities at Williamson, W. Va. The work includes a number of buildings, 1,000,000 cu.yd. of excavation, 3,000 cu.yd. of reinforced-concrete masonry, and about 20 miles of additional trackwork in the terminal yard. The estimated cost is $2,500,000.

Highway Toll Bridge Opened to Traffic in California

On New Year's day the first traffic crossed the mile-long highway bridge of the American Toll Bridge Co. near the mouth of the San Joaquin River in California. This structure, No. 7 in the table of San Francisco bay bridges, published in *Engineering News-Record*, July 30, 1925, p. 178, was opened with a toll rate of 75c. per car and 15c. per passenger, the same fares that obtained on the ferry it replaced.

Engineer Cannot Be Ousted by Recess Appointment

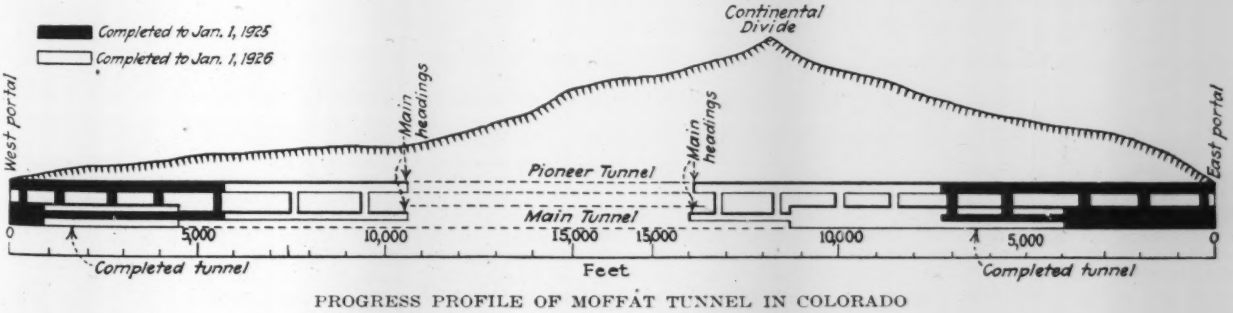
Will R. Murphy, engineer of the Colorado landboard, cannot be ousted by a recess appointment, according to a ruling of the state supreme court. To remove him for political reasons it must be done during the session of the legislature and only then if the senate confirms a successor, the successor to be named by the governor. The senate has refused to confirm the governor's selection and, therefore, Mr. Murphy will hold the position until 1927.

Moffat Tunnel Headings More Than Three Quarters Through

On Jan. 1, 1926, the main headings and the water tunnel headings of the Moffat Tunnel in Colorado, had been driven 78 per cent of the way through the Continental Divide and the railroad tunnel had been enlarged to full section for 51 per cent of the distance. The following table gives the figures as of Jan. 1, 1926, and the diagram shows the progress made during the year 1925.

	From East Portal Ft.	From West Portal Ft.	Total Ft.	Per Cent Finished
Water tunnel	14,246	11,022	25,268	78.3
Main headings	14,222	10,969	25,191	78.0
Cross cuts [1]	567	441	1,008	77.0
R. R. (full size)	11,649	4,652	16,301	51.0

[1] Cross cuts connect the two parallel tunnels.



PROGRESS PROFILE OF MOFFAT TUNNEL IN COLORADO

Engineering Societies

Calendar

Annual Meetings

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 11-15, 1926.

AMERICAN ENGINEERING COUNCIL, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 14-15, 1926.

NATIONAL DRAINAGE CONGRESS, Chicago, Ill., Annual Convention, Oklahoma City, Okla., Jan. 18-20, 1926.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Portland, Ore., Jan. 19-23, 1926.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 20-22, 1926.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Toronto, Ont., Jan. 27-29, 1926.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 23-26, 1926.

The Western Society of Engineers at its meeting on Jan. 18 will have a paper on "Economics of Grade Reduction and Reduction in Mileage," by Charles A. Morse, chief engineer of the Chicago, Rock Island & Pacific Ry.

The Wyoming Engineering Society will hold its annual meeting at Casper Jan. 22-24, Jan. 22 and 23 being devoted to business sessions, technical papers and election of officers, and Jan. 24 to field trips to the Salt Creek oil field, the Casper oil refineries and the city water supply system and pavement construction.

The Society of Terminal Engineers, at its annual meeting held in New York City, Jan. 8, 1926, elected the following officers for the year 1926: Wm. Joshua Barney, New York, president; Carroll R. Thompson, Philadelphia, Billings Wilson, New York, J. J. Vail, Newark, George W. Osgood, Tacoma, and E. J. Noonan, Chicago, vice-presidents.

The National Drainage Congress meets Jan. 18, 19 and 20, in Oklahoma City, Okla. Farm relief, flood control and agricultural land settlements are the chief topics to be taken up. Large flood prevention projects in the southwest, particularly the recent activity to control the Arkansas River by the states of Oklahoma, Colorado, Kansas, Texas, and New Mexico, will receive attention. C. R. Thomas, Chicago, is secretary.

The Illinois Section, American Society of Civil Engineers, on Jan. 5, elected the following officers for the ensuing year: Chairman, J. N. Hatch, and secretary-treasurer, W. D. Garber. E. S. Nethercut, reporting for the new employment service department of the Western Society of Engineers and the four founder societies, stated that engineers are so well employed that not a great deal of success in placements has been had since the service was started 4 months ago.

A Kansas Section of the Southwest Water-Works Association was organized among the water-works men present at the fourth annual three-day school conducted in December by the University of Kansas School of Engineering at Lawrence; the new organization will take over the direction of future annual conferences in co-operation with the faculty of the School of Engineering. Officers elected for 1926 are: President, R. J. Paulette, Salina; vice-presidents, B. L. Ulrich of Manhattan, D. A. McGinnis of Humboldt, L. B. Mangum of Kansas City (Kansas), and Clyde B. King of Eldorado; secretary-treasurer, Prof. E. A. Boyce, of Lawrence.

Personal Notes

GEORGE C. ANDREWS, Buffalo, N. Y., water commissioner, who has been in charge at Buffalo's new filtration plant since 1921, has resigned. Mr. Andrews was appointed supervising engineer of the Buffalo Bureau of Water in 1916 when the commission form of government was adopted by the city; later he was made water commissioner, and still later also engineer for construction of the city's new filtration plant, in which work he will continue. He ran for member of the city council in the election of November, 1925, but was defeated.

FRANK S. KRUG, who since 1914 has been city engineer of Cincinnati, Ohio, and since 1917 also engineer of the Cincinnati Rapid Transit Commission, has resigned. FRANK L. RASCHIG has been appointed to succeed him. Mr. Raschig has been principal assistant engineer in charge of the Division of Structures in the Cincinnati Department of Public Works; he is a graduate of the University of Cincinnati and was formerly bridge engineer in the Division of Structures.

WILLIAM A. SCHUNK, who for a number of years has been city engineer of Scranton, Pa., has been appointed director of public works of the city of Scranton.

MARCUS K. BRYAN and R. A. MONCRIEFF, who for some time have been connected with the firm, Charles T. Main, engineer, Boston, Mass., have been made associates in the firm.

GORDON C. SNYDER, division engineer of the sixth state highway district of Ohio, is moving the headquarters of this district from Columbus to Marion, Ohio, as announced by State Highway Director G. F. Schlesinger; Mr. Snyder will have two assistants in the work at Marion.

RALPH R. WHITE, road maintenance engineer for Cuyahoga County, Ohio, for the past four years, has resigned to become president of the Engdel Co., engineers, with offices in the Chester-Twelfth Building, Cleveland, Ohio. Associated with him is CARL H. BAUER as chief engineer of the new firm, formerly a member of the firm of Bauer & Bauer, engineers, of Dayton, Ohio. The firm will engage in general engineering business but will specialize in highway construction and maintenance and the handling of highway construction equipment and materials.

ALEX O. TAYLOR, junior member of the firm of Butler, Barnett & Taylor, West Palm Beach, Florida, has recently been appointed county engineer of Palm Beach County to succeed George O. Butler, senior member of the firm, who resigned on account of ill health.

Obituary

WILLIAM O. CROSBY, geologist and former professor at Massachusetts Institute of Technology, died at his home in Boston Dec. 31 at the age of 75 years. As geologist, Professor Crosby was consulted regarding the construction of the Muscle Shoals dam, by the New York City Board of Water Supply regarding the Hudson River siphon, and regarding the Wachusett dam and reservoir, the Nashua tunnel, aqueduct and distribution system, the Boston subways and tunnels, the South Boston dry dock, and the new buildings of the Massachusetts Institute of Technology. Professor Crosby was born in Ohio, and graduated in 1876 from, and in 1883 became professor of geology at Massachusetts Institute of Technology. He was the author of many mineralogical and geological works.

HECTOR VON BAYER, Washington, D. C., an engineer who assisted in planning the cables for Brooklyn Bridge, died Jan. 8 at the age of 81 years. Mr. von Bayer did engineering work in connection with lighthouse and life-saving works construction, for a time was in the United States Hydrographic Office, and was connected with many naval and coast engineering works. He was born in Baden, Germany, and graduated in civil engineering from the Polytechnic School at Karlsruhe.

MILTON F. STEIN, sanitary engineer, Chicago, died Jan. 2, at the age of 40. He was the author of "Water Purification Plants and Their Operation" and responsible for much of the design of the original Cleveland filtration plant under the late R. Winthrop Pratt. Graduated from the University of Illinois in 1909, he entered the employ of Chester & Fleming for three years. For a year he was with Hering & Gregory, then with Pearse & Greeley. Later he was with the Sanitary District of Chicago, and with C. A. Jennings prepared plans for the Jennings sewage screen. During the past five years he had been an associate of Goscoigne, Harvey & Jones, consultants, Cleveland, but on account of ill health spent much time at his home in Chicago where he worked as he was able on problems of the International Filter Co.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Equipment Distributors Hold Meeting

A. C. Blaisdell, of Queen City Supply Co., Cincinnati, Elected President—To Meet Next Year in Chicago

Engineering News-Record Staff Report

A COUNTRY-WIDE representation of member organizations featured the seventh annual meeting of the Associated Equipment Distributors, held in Milwaukee Jan. 5 and 6. The first day's session was closed to all but members and concerned itself with problems of internal organization, trade relations, legislation, salesmen's compensation and the costs of distribution. On the second day, however, a joint open meeting was held with the manufacturers of construction equipment and after the opening address by President Morton R. Hunter, of the Hunter Machinery Co., Milwaukee, Russell T. Gray, of Chicago, president of the advertising agency which bears his name, discussed methods of getting results from advertising and J. F. Gallagher, secretary of the Illinois Association of Highway and Municipal Contractors, outlined the policies that govern contractors in the selection and purchase of machinery and materials. The attendance at the joint session was about 150.

The Associated Equipment Distributors added ten new members to its roster at this meeting, bringing the total membership up to 66 companies operating in all of the principal construction territories of the United States.

New Officers

The following new officers were elected to serve for the current year: president, A. C. Blaisdell, Queen City Supply Co., Cincinnati; first vice-president, R. E. Boehck, Boehck Machinery Co., Milwaukee; second vice-president, Harry Fletcher, Clyde Co., Inc., New Orleans; secretary, Morton R. Hunter, Hunter Machinery Co., Milwaukee; treasurer, W. B. Louer, of the W. B. Louer Co., Chicago; director, Edw. R. Bacon, Edw. R. Bacon Co., San Francisco. Chicago was chosen as the place of the next annual meeting.

Presidential Address

In his presidential address Mr. Hunter sketched the history of the organization since it was established in 1919, showing how during that period the irresponsible "desk merchant" had been gradually superseded by the reliable equipment distributor, with an organization qualified not only to promote sales but also to render service to the contractor in the form of repair parts and periodic overhaulings of worn machinery. He decried the practice of certain manufacturers in appointing distributors to break open new or difficult territories and then, after the missionary work had been done, replacing the distributor by a company representative or branch office.

Possibilities for co-operation between manufacturer and distributor, said Mr. Hunter, are found in a refusal, by the distributor, to take on more lines than he can handle effectively, and in a practice by manufacturers of supplying complete repair parts lists simultaneously with the placing of a new model of machine on the market—not several months after this event.

Advertising

Mr. Gray's talk on advertising covered the several mediums available and their proper application to the construction equipment field. He stressed the importance of proper market analysis and suggested the industrial field as a supplement to the construction field as an attractive possibility for the development of new business. "Advertising designed primarily to pull inquiries," said Mr. Gray, "is poor advertising." Its larger purpose, he explained, is to build prestige for the product and its maker and assist the efforts of the distributors' salesmen, whom no form of advertising can replace.

The Contractor's Point of View

Speaking from the point of view of the contractor, Mr. Gallagher pointed out the financial danger facing the contractor who over-equips his job. In selecting equipment, he said, the contractor is influenced, first, by the quality of the product and its performance; second, by the service facilities that the distributor is able to give in the form of prompt shipments of repair parts; and third by price. Mr. Gallagher said that the responsible contractor of today avoids a policy of purchasing only on price. Changes of models of machines should be discouraged, he said, to the end that the construction job shall not become an experimental laboratory for the manufacturer. Radical changes in design should undergo exhaustive tests at the manufacturer's plant before being incorporated in machines offered to the field.

Production of Motor Vehicles Reaches New High Figure

Production of motor vehicles in 1925 reached a new high record of 3,833,000 cars and 492,000 trucks or a total of 4,325,000 according to a statement issued by the National Automobile Chamber of Commerce. The highest previous year's production was in 1923 when 4,086,000 cars and trucks were produced.

The wholesale value of cars and trucks manufactured this year approximates three billion dollars.

The year 1925 was particularly favorable for the motor truck industry. The 492,000 trucks produced represent nearly 12 per cent of the total output of the industry.

This year the export figures passed 550,000 as compared with 386,000 last year. Accordingly, it is clear that a large part of the new record in production should be credited to the foreign market.

Business Notes

Eastern Paving Brick Manufacturers Association, Philadelphia, Pa., held its annual meeting in New York City, Dec. 8. The day was occupied by the business meeting and all officers were re-elected for the coming year. These officers are as follows: R. L. Winslow, New York, president; R. T. Hutchins, Wilkes-Barre, Pa., treasurer; W. C. Perkins, Philadelphia, Pa., secretary; W. W. Cunningham, Pittsburgh, Pa., F. L. Stowell, Olean, N. Y., C. C. Blair, Canton, Ohio, J. W. Hall, Baltimore, Md., vice-presidents; C. P. McFadden, Toronto, Ohio, governor; D. R. Potter, Clarksburg, W. Va., alternate.

Equipment and Materials

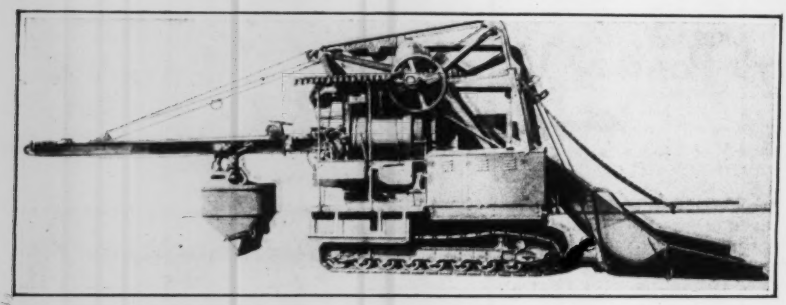
[Additional descriptions of new and improved road building machinery, others of which appeared last week.]

Heavy-Duty 27E Paver Has New Automatic Features

The heavy-duty 27E paver recently brought out by the Koehring Co., Milwaukee, Wis., has a 7-bag capacity 1:2:3-mix proportion or a 6-bag capacity 1:2:4-mix in accordance with A.G.C. standards. Among the automatic features of this new machine are centralized high-speed control, automatic high-speed water feed through a balanced valve, a power discharge, power steering of crawler treads, double continuous self-equalizing cables for the charging skip, self-spreading boom bucket, automatic loading action, and a collapsible upper frame for clearing low overhead obstructions.

A completely inclosed set of gears through which the power is distributed is connected directly to the motor by a flexible coupling. The connection between this set of gears and the drum drive shaft is the same type. All of the gears in the case run in a continuous bath of oil. The paver is steered by power; turning the steering wheel actuates a lever reduction, which disconnects one crawler tread while the other is engaged to operate.

An air pressure tank may be connected to the water tank causing the water to be rapidly discharged into the drum. By using this compressed-air system the time during which the materials are in the drum is materially decreased in such states where the full minute mixing time is computed from the instant the water has ceased flow-



ing into the drum. A balanced, plunger type water valve automatically opens when the skip raises.

The operating levers are so placed as to give advantages in increasing the speed of the paver. The platform is made in two sections, so that the outer part can be removed in order to reduce the overall width of the machine. Also when constructing half width roads the traction width of the crawlers can be readily changed from 90 in. overall to 82 in. overall.

The upper steel framework can be collapsed and folded down by removing a few bolts and disconnecting the water line. The total height from the ground to the top of the machine can thus be reduced to 11 ft. 3 in. Power is supplied by a Waukesha four-cylinder engine, running at 1,100 r.p.m.

Optional equipment includes disk wheels with rubber tires or steel rimmed wheels instead of the crawler traction. A single-batch transfer derrick, attachable to either side of the machine, can also be supplied. The paver may also be equipped with a self-compensating discharge spout, which has a maximum swing of 180 deg., giving distribution to both sides of the paver.

Hoist Clutch Set by Air on New Power Shovel

The new gasoline power shovel manufactured by the McMyler-Interstate Co., Cleveland, Ohio, incorporates some new and unique featurese. Since, in a gasoline shovel, hoisting, swinging and crowding must all be performed by the same engine, friction clutches are necessary. Considerable physical effort is required to set a friction clutch so that there will be no slippage. On a steam shovel, the main hoist clutch is set by a steam ram. This same ram mechanism which is used on all standard steam shovels is used on this No. 2 gas shovel. Compressed air does the work of steam in setting the clutch. It is not only easy in operation, but has the further advantage of being thoroughly understood by all steam-shovel operators.

The crowding mechanism of the No. 2 gas shovel is also a feature. The shipper shaft is driven by a single chain from a sprocket on a shaft concentric with the boom hinge. This drive makes it possible to raise or lower the boom without altering the length of the crowding chain. The clutches for reversing the direction of the crowding motion are located on a shaft at the foot of the boom. Manual effort in operating the crowding and swinging clutches is reduced to a minimum by means of an eccentric device which multiplies the force applied to the respective hand levers.

Another refinement on this shovel is the manner in which water is used for cooling the engine and for counterweight. The cooling water for the engine is circulated through a tank, located at the rear of the turntable. This circulation eliminates the necessity for a radiator and a fan, and a constant operating temperature for the engine is said to be obtained. The shovel s furnished with two independent power drums with air-operated clutches on each drum, making the shovel readily convertible to a 10-ton crane for bucket service. As a shovel, the machine handles a ⅞ or 1-cu.yd. dipper.

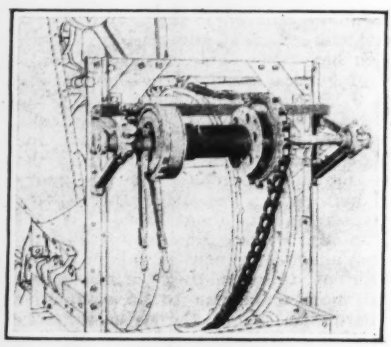
Improvements Made on Hopper for Measuring Aggregates

The aggregate hopper manufactured by the George Haiss Manufacturing Co., Inc., New York, N. Y., has been improved for handling aggregates on concrete paving work. The hopper is designed for use with the company's crawler mounted elevating bucket loaders. The hopper consists of two parts, the lower of which telescopes inside of the upper being hung from it by four threaded bolts which are claimed to give a micrometer adjustment of capacity.

The guide chute on the bucket elevator extends inside of a stationary receiving head on the hopper, thus eliminating any possibility of spillage of material. A cut-off plate riding on four ball bearing rollers and operated by a hand lever at the operator's platform cuts off any excess material. A tell-tale shows when the hopper is full. The discharge chute is carried by the lower section of the hopper. A swinging gate interlocked with the cut-off plate, closes the discharge chute and is controlled from the operator's platform. The minimum clearance above the ground under the hopper and its carrying frame is 6 ft. 9 in. at the discharge end of the chute. The hoppers will discharge either to the front or the sides and are available in sizes of 12 to 22 cu.ft., 17 to 25 cu.ft., and 8 to 15 cu.ft.

Hoisting Attachment for Use On Building Mixers

A new hoisting arrangement that is now being placed on the market as an accessory for Rex mixers is manufactured by the Chain Belt Co., Milwaukee, Wis. This hoist has been designed especially for light hoisting work and may be put on the mixer in the field without requiring any change in the machine itself. It is capable of hoisting loaded wheel barrows, small elevators and doing other general hoisting work for the contractor whose construction work is not large enough to warrant the expense of a special hoist. It attaches directly to the mixer frame and is driven from the mixer drum chain. The hoist shaft is mounted on self-aligning bearings which prevent the shaft from springing or becoming out of line.



The winding drum will take 400 feet of ⅜-in. cable and is capable of handling 1,200 lb. at a speed of 40 ft. per minute on a double line pull. It is pointed out that there is a special advantage in a hoist of this type when laying concrete for curb or gutter work for the machine can be moved along on its own power by fastening the cable to some stationary object ahead.

Publications from the Construction Industry

Concrete Mixers. — AMERICAN CEMENT MACHINE CO., INC., Keokuk, Iowa, recently issued a series of bulletins describing its concrete mixer line. Bulletin 232 includes illustrative specifications of Boss heavy duty tilters. Bulletin B-27 describes Boss heavy duty mixers, and bulletin 117 is devoted to Boss single and double drum hoists.

Jacks.—A. O. NORTON, INC., Boston, Mass., in its catalog 34 describes its complete line of ball-bearing jacks. Also bridge and wrecking jacks, locomotive and general purpose jacks, track jacks and many other special designs are described.